ELECTRICAL REVIEW

ILLUSTRATED.

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VIEWS, NEWS AND INTERVIEWS.

Platinum enters very largely into electrical work, and the report that it has been found on the Pacific coast in such quantities and of such quality as to make it profitable to mine, will prove of interest particularly to incandescent lamp manufacturers. While platinum has been known to exist in this country, it was of such poor quality that it could not be collected with profit, and up to the present it has all been shipped here from Russia. This will be changed now.

Copper is a substantial commodity, indeed. It is related that a large buyer went to a broker representing the syndicate controlling the output, on December 31, and asked for a quotation on 300,000 pounds. "17 cents," was the reply. "Yes, but it will be less than that to-morrow; let me have the benefit of the reduction, so I can make my bid to-day to my customer," said the buyer. "Can't do it," was the reply. "Copper is 17 cents to-day, and I'll sell you at that price only, and deliver when you please." The buyer declined to purchase that day, but took the chance of the decline in making his bid, and the next day, January 1, had considerable satisfaction in pricing copper at 15 cents. This gives a little idea of the independence of the miners of copper.

New York is to have a Columbus arch at the Fifty-ninth street entrance to Central Park. An important part of the decorations of the arch will be electric fountains.

Coast duty was resumed on September 1 by the United States life saving crews who do duty along the shores of Long Island. Their season closes at midnight on the last day of April and opens at midnight on the first day of September. There are more than 50 stations on Long Island, and all are connected by a special telephone system that skirts the entire coast.

The new "catelectric apparatus," illustrated and described in a recent issue of the REVIEW, is being published, picture and all, in the daily press of the country. Some of our editorial friends seem to have taken the article seriously, heading it "The Latest Electrical Novelty."

Mr. J. R. Keene, the well-known broker of New York, is reported as saying: "General Electric is earning 17 per cent. per annum on its stock. This is exclusive of stocks received by it from corporations organized at various points to do business in special lines, such as electric lighting, etc., which get the authority to use the patents owned by the General Electric Company. Its business is continually expanding, and it is only a question of time when the present rate of dividend, two per cent. quarterly, will be increased. Any person who can buy the stock and will hold it firmly until next year will get a large advance, not only in the price of the stock, but in the dividend."

A prominent electrical man, a manufacturer of a fine arc lamp, become enlisted on the side of Corbett; took a flyer on a ten to one combination for $100 and cleared up $1,000; besides, Sullivan's defeat on other wagers at odds of four to one brought in $2,000 more. Electrical men don't often bet, but when they do they generally score on the winning side.

The New Dynamo and Other Work of the Germania Electric Company, of Boston.

The new dynamo of the Germania Electric Company, illustrated in Fig. 1, is one notable for several important engineering particularities, rather than for any striking departures from well established ideas in construction.

The aim has been to design a machine which will not only combine high efficiency with slow speed in running, but also one which can be manufactured at the lowest possible cost for good construction, and accordingly lend its aid to the general extension of the benefits of the electrical distribution of energy.

Being thoroughly iron-clad and of the consequent pole type, this machine has also the advantage of a complete magnetic circuit in every part and no liability of irregular pole action, as is often the case where keepers are bolted to the magnets, or, in fact, whenever there is any break in the magnetic circuit and reliance is put upon bolted surfaces.

This avoids, as far as possible, whatever

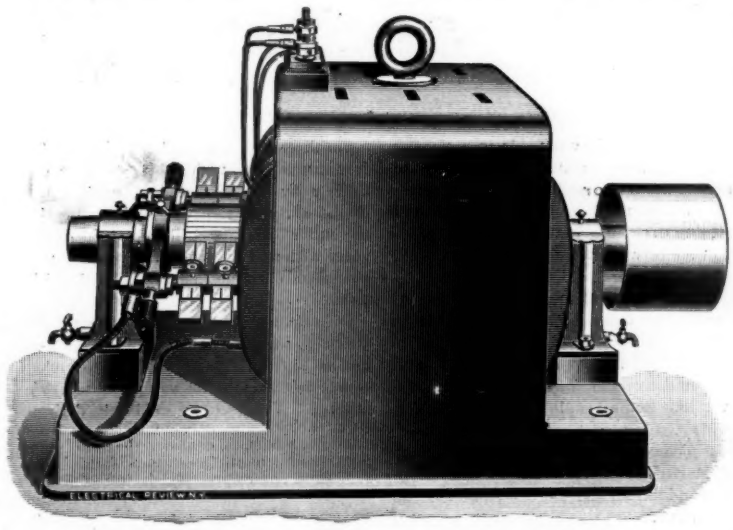


FIG. 1.—NEW DYNAMO OF THE GERMANIA ELECTRIC COMPANY.

irregularities in the line of commutation and consequent sparking due to the construction of the fields. The magnetism in these fields, while kept well below the point of saturation of the cast-iron, is made very intense per unit of armature surface, and, as a result, in spite of the slow speed at which they are run, there is but one layer of wire on the armature, thereby insuring perfect balance and smooth running, free from any vibration whatever, which, on account of the particularly solid character of the bearings and small height of the machine, cannot be due to any other cause than imperfect balance, even when the foundations are not the most perfect.

The commutator bars are massive and long, giving a good bearing surface and high conductivity, hence, coolness in running, while the wires leading to them are carried along the surface of the underlying wire, thereby not including any inaccessible space for the accumulation of dirt and dust, rendering less liable any short circuiting from such a cause.

The journals are large and long in proportion to their diameter, and the bearings are loose ring, self-oiling; babbitted in the types larger than the three kilowatts, while for the smaller sizes a bored and reamed brass box is preferred.

The original designs for these machines were purchased of the Continental Dynamo Company, of New York, having been acquired by them from the Lahmeyer Company, of Germany, but all the different sizes have since been carefully re-calculated and re-designed under the supervision of Captain A. de Khotinsky, the superintendent of the Germania Factory at Marlboro, Mass.

This factory has been in process of construction for the last year and has been fitted by Captain de Khotinsky with the complete apparatus of his own design, and built under his eye, necessary for the manufacture of his celebrated incandescent lamp, and is now ready to produce his very high efficiency filament, as also the Germania dynamo, the Khotinsky quick break station switch, the Khotinsky storage battery, and other minor details of the complete system owned and installed by the Germania Company.

One notable feature in this system is a complete plant for villa lighting, deriving the power from a windmill and storing the electricity generated by a small four pole dynamo in a storage battery of sufficient size for the lighting which may be required about the buildings and grounds of a handsome country seat, which, with the high efficiency lamps used, does not in such an installation make the cost of house lighting exceed by any considerable amount the cost of maintenance of oil lamps, while allowing a flexibility for fetes which cannot be attained in any other manner.

A great deal of attention has also been given to ornamental lamps of various colored and figured glasses, and one lamp of a variegated glass gives a most beautiful effect, which puzzles one to imagine how it is possible to produce such delicate shadings from one color to another in a single piece of glass.

The storage battery spoken of is the result of many years of study by Capt. de Khotinsky, and, while giving a very great number of ampere hours per pound of lead, is so constructed as to be perfectly free from any injurious buckling when continuously used, or even when excessively discharged, while at the same time it has been judged by the highest experts of Germany to be entirely free from any infringement of any earlier patent, either on account of its form or manner of manufacture, both of which are entirely novel.

In all of these particulars it is to be seen that the Germania Electric Company has kept well abreast of the progress of electrical engineering in this country, and controls a system embodying important advances in electrical and mechanical design.

LIGHT AND POWER STATIONS.

SOME HINTS TO OWNERS AND OPERATORS BY A PRACTICAL ENGINEER.

Specially Constructed Buildings Required for Stations—Less Regular Help Necessary Then—The Curse of "Temporary" Work Strongly Characterized—Mr. MacKie is Eloquent and Emphatic on This Subject.

BY ROBB MACKIE.

VII.

Again the plan of leasing or buying a building just because "it is at hand and can be secured cheap," "has a central location," or "where a few alterations will make it just the place for a station," cannot, on general principles, be too severely condemned, for it is the rarest thing to find a building which is or can be made suitable for an electric light or power plant, unless it be entirely torn down and rebuilt. It is so rare a coincidence to find a building erected for other purposes that is suitable for even the smallest kind of an electric plant, that it is safe to warn inventors against them as a delusion and snare. Having visited many plants located in buildings found ready at hand, into which, after more or less alterations, the boilers, engines and electrical machinery have been crowded, and found, with one single exception, that the price paid for the property or rental on same would have paid for a thoroughly appropriate building on the one hand, or paid fair interest on a mortgage and established a sinking fund to pay off on the other, there is ground for taking this position. Especially as it is found that generally in buildings of this class more help is required to attend to the machinery than in properly designed stations, thereby greatly increasing the operating expenses, while the jar and strain of the fast running machinery causes the walls to settle and crack, throwing the machinery so much out of line as to make it difficult to run without excessive use of oil or requiring expensive repairs and stiffening of the building in order to keep it from tumbling down.

Before going further, and right here, as it were, at the outset of the subject of the work to be done on the various parts of the plant, seems the most fitting place to enter another protest against the introduction of so much temporary work into electrical enterprises. It is a fact that stares one in the face at every turn, and is, unfortunately, as common in the work being done at the present day as it was a few years ago, when we had the flimsy excuse of not knowing any better. Again and again has the warning cry been raised in the electrical press and unheeded by the plant owners, by their superintendents and workmen under them, and by the contractors and their forces.

Again has Mr. Harris, in the *Electrical Engineer*, raised the warning cry pointing out the folly of "temporary" work, and while many have listened in the past and taken heed and foresworn this false siren, who has lured so many to their own undo-

ing, many others go on and on, doing a piece of "temporary" work here, which is likely as not to remain for years, and another there, and another some place else on their lines, with a reckless disregard of the rights of property holders and the lives of the men in their employ or that of other kindred enterprises in the same city. The same old story, "That will do for to-day; we will come back and fix it up another time." On and on, with the same recklessness as to life and property, forgetting in their foolish economy that every time a man is hurt or a fire started by electricity an incalculable setback is given to the industry, and leads to the raising anew of the cry against the "deadly electric wire."

It is not an exaggerated view to take of this question that, if the grim roll was called, more than one-half of the men who have "joined the silent majority" by the electrical route would answer to their names, "Death due to a piece of *temporary* work!"

"Oh, ye fools and blind hypocrites!" on and on you go to your own undoing. It is impossible to estimate how much you have retarded electrical development on the one hand, or to know the number of "horrors" you are responsible for on the other, with your slip-shod, "temporary" work!

Fate has indeed been kind to you in the past in many places, but the "burial of the wires" in others is only a just retribution that has overtaken you for your shortsighted, criminally careless policy.

And the funeral march of the wires will not be stayed, for now that it has been begun and the "burial service" has been found effective, the band will continue to play the dirge to the bitter end. And as the wires go down, many of you, standing by the graves, can comfort your hearts with the thought that the expense and difficulty of the work has been brought upon your own heads, owing to your past carelessness in doing the work, and can congratulate yourselves that you have escaped an indictment for manslaughter as one of the direct results of some of your *temporary work*.

(To be continued.)

Earth Currents.

READ BEFORE SECTION A OF THE BRITISH ASSOCIATION, BY W. H. PREECE, F.R.S.

The year 1892 has been remarkable in the number and severity of those electric storms which interfere so seriously with telegraphic communication. Unfortunately, observations made upon them on working circuits are rarely reliable. Their arrival and departure are sudden; they come when they are least expected, and they occur in busy hours when the wires are fully occupied with more remunerative currents, and when the staff is fully engaged. Their presence, duration and relative intensity are so exactly coincident with magnetic disturbances that the recorded observations in magnetic observatories of needle observations may be taken to indicate the same elements of earth currents also, but they do not give their direction, nor their absolute intensity. Their general direction is determined by the simultaneous observations of many circuits running in many directions and noting the lines of maximum and those of no disturbance. This gives the position of the equipotential planes on the surface of the earth, and the intensity of the currents gives the difference of potential between these planes.

I have not succeeded in obtaining definite facts to prove that these planes are perpendicular to the line joining the center of the earth and the center of the sun, but there is little doubt that it is so, for telegraph circuits running in this direction experience the maximum disturbances, while those running at right angles on the equipotential planes suffer no disturbance. Those that experience the maximum disturbance in the forenoon are not affected in the evening, and *vice versa*.

The storms commenced on January 4, and they have been observed at frequent intervals since.

The great storms occurred on February 13, March 12, April 24 to 27, May 18 and July 16.

The intensity of the maximum currents observed in England frequently exceeded .045 amperes (or 45 milliamperes), which much exceeds in strength the working currents. Hence, ordinary telegraph working was paralyzed, and we had to resort to metallic circuits and to the use of condensers to maintain telegraphic communication.

The effect of such currents on our railways might be positively dangerous, for they ring bells and reverse the block signals.

.048 ampere means .54 volt per mile, so that the equipotential planes differing by one volt would have been placed about two miles apart.

These earth currents, though variable, are always continuous, and give no indications of alternations.

The simultaneous appearance of aurora show that disturbances on the sun's photosphere, as indicated by sun spots, produce electrostatic and electro-magnetic effects on the earth's surface of enormous magnitude.

The appearance of earth currents is invariably simultaneous over the whole globe.

Observers abroad would benefit science if they would record the maximum strength, in milliamperes, of the currents received, the geographical direction of the terminal earths of the circuits affected and unaffected, the resistance, in ohms, of the circuits on which the currents are measured, and, if they can, to give the times of duration in Greenwich, and not in local time.

Stole the Telephone Operator.

The perfect serenity and peaceful tranquility of the idyllic town of Tompkinsville, S. I., were broken early yesterday morning by a remarkable incident. At 2 o'clock A. M., a man entered the telephone office, stole the telephone operator and carried him off.

Tompkinsville has been in a state of panic ever since. It is feared that the mayor may be stolen next.

Mr. Caffrey is an unusually quiet Staten Islander, who fought, bled and almost died for his country. He survived the perils of York, had just said "Good-night" over the telephone to his sweetheart in Perth Amboy, N. J., when the door of the office opened and a man with a huge club and eyes with an insane light in them, staggered into the room. It was Caffrey. He had a touch of the "horrors."

He imagined that he was a New Jersey detective—an "Old Sleuth" or Hawkshaw, who had run down a prisoner. Brandishing his club, he told young Finnerty that he was a detective from Jersey City and had come to arrest him, and would take him along, alive or dead.

The man fixed his delirious eyes on young Finnerty, seized him by the arm, and, with a strength which seemed supernatural, dragged him out of the chair and out of the office. The resistance of the youth was powerless against the delirious strength of the man. The pressure of the man's clenched hands was so great that Finnerty's arm was black and blue.

The delirious man carried off Finnerty as Mephistopheles carried off Faust. He dragged him up the street with a grip of iron and the strength of three men. He still carried his heavy club and repeated that he would take Finnerty to New Jersey, dead or alive. Up the silent street went the man who was temporarily a maniac and the helpless prisoner. About a quarter of a mile from the telephone office, William Smith, a butcher, came along in his wagon, on his way to the ferry. Young Finnerty called to him for help. Smith at once jumped down from his wagon and ran to the young man's assistance.

Caffrey brandished his heavy club in the air and said: "I am a detective from Jersey City, and I will take you in, too."

FIG. 2.—ARMATURE OF NEW DYNAMO, GERMANIA ELECTRIC COMPANY.

the battlefield and lived to draw a pension from a grateful country. Tuesday he marched up to the pension office as bravely as he ever marched up to a battery of artillery, and drew his pension. It had been a long time between pensions, and Mr. Caffrey was thirsty.

With his patriotic earnings Mr. Caffrey proceeded to brace up his nervous system for other possible wars. He bivouacked in a saloon and fought all his battles over again, and three or four wars that he was never in. Some people like a hero's bier, but Mr. Caffrey preferred a soldier's beer! At 10 o'clock P. M. Mr. Caffrey broke camp and started to march for Whitehall slip. About midnight Mr. Caffrey debouched on the Battery.

After making several flank movements on Pier A and three or four strategic feints at the Barge Office, he advanced straight at the Staten Island ferry, and took the ferry-boat. Mr. Caffrey was full of enthusiasm. He was going to Staten Island to paint it red.

At 2 o'clock yesterday morning Tompkins avenue, in Tompkinsville, was as dark as a plot in one of William Black's novels. Everybody in Tompkinsville had been asleep four hours. The bullfrogs had ceased to sing in their pure baritone or basso-profundo voices, and the mezzo soprano of the katydids was hushed. At this hour the only light in Tompkinsville was in the window of the New York and New Jersey Telephone office in Tompkins avenue.

Young Mr. John B. Finnerty sat by the light, struggling with the mysteries and complications of the telephone service. It was so quiet that he could almost hear the shadows come and go on the wall. Mr. Finnerty thought it was a grewsome night, and if anybody came in and tried to tell him a ghost story he would send for the police.

A young man in Madison Square, New Smith grappled with the madman. Caffrey struck him with his club. Smith caught Caffrey by the throat and choked him. Then he tripped Caffrey and flung him into the gutter. Caffrey still kept hold of Finnerty with an iron grip. The prisoner made a supreme effort and succeeded in breaking away.

Policeman Cannon arrested Caffrey. The prisoner was taken before Justice Casey, but as young Finnerty declined to make a charge against him, he was permitted to go at large. The man was evidently delirious from drink, and irresponsible. Some of Finnerty's friends consider that the young man was fortunate to escape with his life.

Yesterday two pretty girls were in charge of the telephone office. Up to last evening no one had carried them off. It is not known how soon they will be stolen.—*New York Morning Journal.*

Electrical Tanning of Dog Skins.

A writer in a French paper states that all the strayed dogs taken up by the Paris police and left unclaimed are, after being killed, handed over to an enterprising manufacturer, by whom the skins are tanned by electricity. Instead of taking seven or eight months to transform the skin into leather, as is the case by the ordinary system, electricity does the work in three or four days. The leather so tanned, moreover, it is asserted, is much better than that manufactured by the ordinary process, and when made up into ladies' boots and shoes is much admired for its soft and delicate qualities.—*London Electrical Engineer.*

At Lowell, Mass., a new electric headlight is being tried on the cars. It is placed near the top of the car in the center of each end and consists of an incandescent lamp surrounded by a powerful reflector. The light given is strong and strikes the ground 20 feet from the car. It may prove a great advance over the heavy lanterns now in use.

TELEPHONE TALK AND COMMENT.

Capt. Geo. N. Stone, general manager of the City and Suburban Telegraph Association, has completed the single duct subway system in Cincinnati and contracted with the Western Electric Company, of Chicago, to furnish, draw in, splice and connect about 100,000 feet of underground cable. Captain Stone was gratified, on opening bids for cable, to find that the Western Electric Company made a discount and the John A. Roebling's Sons Company made an allowance per foot on account of the superiority of manholes and the single duct subway system, which is not only an indorsement of the single duct system, but enabled him to secure cable at prices lower than heretofore made. He has also contracted with the Western Electric Company for their latest improved multiple metallic switchboard and equipment for the new central exchange, to be located in the new building on Vine street, now being pushed to completion. The Cincinnati company has always been credited with giving good telephone service at very reasonable rates. When their underground cable system and new exchange is completed, the users of the telephone in Cincinnati may congratulate themselves upon having the latest and most improved telephone system to be found in any city, and to Captain Stone is due the honor for this progressive work.

Paul W. Bossart, a well-known telephone man of the West, but recently in electric railway work, has accepted the agency of the National Electric Company, of Eau Claire, Wis., with headquarters in Chicago. Mr. Bossart has many friends in electrical circles and is a capable electrician.

President Harrison and Mr. Whitelaw Reid can converse at will (at regular rates) over their long distance telephones between the White House and Ophir farm, the home of the candidate for vice-president. If they don't talk in this way it is not due to lack of the telephone facilities.

Mr. T. D. Lockwood, of the American Bell Telephone Company, who is so well known through his writings on scientific subjects, has established somewhat of a reputation as a purist. He is quoted in the *Century* Dictionary as authority for the word "telephoner," a word which he coined and which first appeared in his hand-book on "Electricity, Magnetism and Telegraphy." The definition in full is as follows, the word being accented on the first syllable: "One who uses a telephone for communicating with another." It is no small compliment to be thus quoted in this notable work.

Mr. F. W. Sabold, formerly in charge of the Western Union Telegraph Company's interests at Albany, has during the past year, as general manager of the Westchester Telephone Company, been reconstructing the telephone system of the Northern suburbs of New York city. As a result, good service into Westchester county can be guaranteed to all subscribers having metallic circuits.

The telephone authorities of New York have been on deck during the cholera scare ready for any emergency. A line from the Mayor's private office to that of President Wilson, of the Board of Health, was provided within two hours. The telephone company stood ready to establish telephone communication with any and all of the cholera pest ships quartered in the lower bay. Although the health authorities decided, for reasons best known to themselves, not to establish such communication, the citizens of New York appreciate the energy of the telephone officials and applaud the sacrifice which a number of the company's employés would have to have made in putting through the work. If such arrangement were completed, at least a dozen telephonists would be quarantined for an indefinite period on the cholera ships and islands. At the time of writing, however, the health authorities had not called on the company for this aid.

An Excellent Lubricating System in Use in Power Stations.

A rather ingenious method for lubricating the wrist and crank pins of steam engines, manufactured by Messrs. Anderson & Horton, of South Brooklyn, is illustrated on this page. The method employed has many decided advantages over the present mode of lubricating the moving parts of an engine. Especially on high speed types is it of great value, for it is not possible by the old method to oil without a considerable loss, but by means of this lubricator there is practically no waste.

A glance at the cut will show the manner of its operation.

It is at present giving entire satisfaction at the Brooklyn City Railroad power house, where it can be seen in operation at any time.

Long Distance Communication.

Under date of July 29, 1892, Charles Proteus Steinmetz, in answer to some remarks published by Mr. Grawinkel in No. 23 of the *Electrotechnisher Zeitschrift*, writes as follows:

As regards the electro-static induction between telephonic, respectively, telegraphic currents and power currents, I am glad to note that this phenomenon has been observed and studied in Germany. On account of lack of time I am obliged to desist from a careful criticism of the experiments made by J. J. Carty in relation to this matter. I wish, however, to refer to his able work.

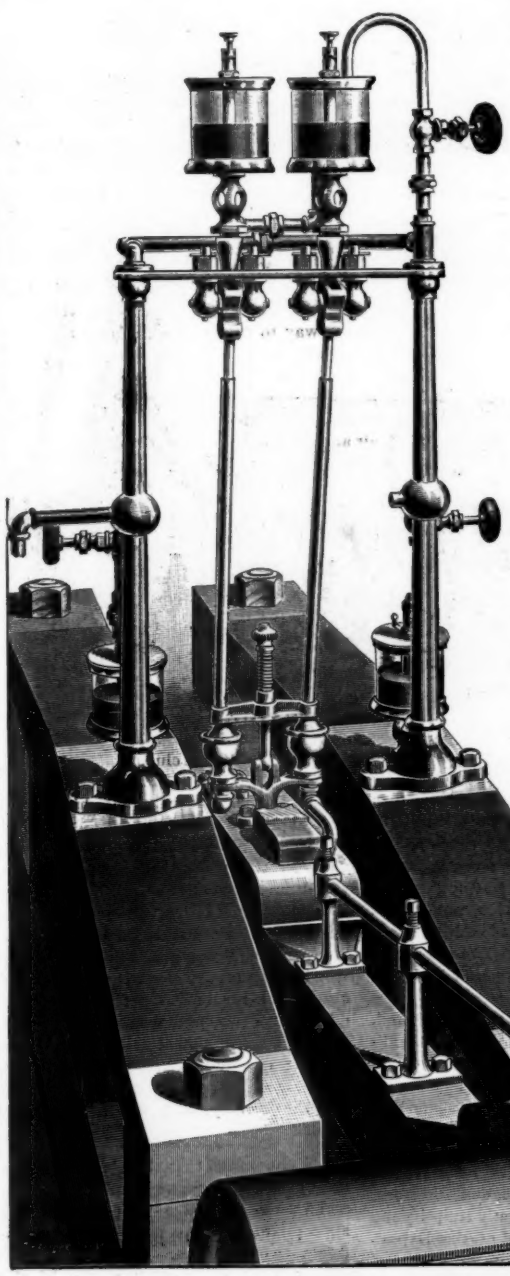
As to the allowable maximum value of the product, resistance by capacity, it depends mainly upon the desired quality of telephonic transmission. The articulation is clear and but little distorted at 10,000; even at 15,000 fair transmission is possible, assuming that the speaker articulates distinctly. Such high values only attain here on long distance lines principally used by business men who are accustomed to speak distinctly. It would be misleading to assume that this value of capacity by resistance is a simple factor, and that a certain defined maximum value can be determined. On the contrary, the allowable maximum value of capacity by resistance depends chiefly upon the physical condition of the microphone and telephone.

As the value of this product increases, transmission becomes more difficult, and finally impossible. This is brought about not by an intermission of the electrical waves, *i. e.*, by an absolute obstruction to their transmission, but by the fact that the upper partials of our language being waves of higher periodicity, are much more enfeebled than the fundamentals. Now, as the characteristic of the sounds of the human language consists principally in upper partials, a weakening of these sounds necessarily produces indistinct articulation. On the other hand, it is evident that a microphone which is so constructed that the upper partials or waves of higher periodicity are reproduced more strongly than waves of lower periodicity, and a telephone which is more sensitive to rapid vibrations than slow ones will articulate distinctly over lines where the average telephone apparatus would be useless.

It follows that while discussing the possibility of telephonic intercommunication we must not only pay proper attention to the condition of the line, but also consider the physical condition of the instruments. By improving our telephonic apparatus we shall be enabled to get good results over lines which are now useless for telephonic purposes.

Mountain Streams as Sources of Electric Power.

Scotland has been fitly termed the land of the mountain and the flood, and a visitor to the Highlands, or, indeed, to the gently undulating slopes of the hills in the Lowlands, must have been impressed, if mechanically inclined, with the great sources of power running to waste. In one or two cases the mountain streams have been utilized for generating electricity; but the number of instances is in very small proportion to the possible total. Within the past week, says London *Engineering*, a plant has been completed for generating electricity to light Overtoun, Dumbartonshire, the fine Scotch baronial residence amidst the hills overlooking the Clyde, and now owned by Mr. J. Campbell White. The installation, which is for 800 lights of 16 candle-power, will supersede special gas works at the house, and it is computed that in three or four years the plant will have paid itself, and the upkeep from year to year in lamps, etc., should not be great. The waters from the hills are gathered into a reservoir of 700,000 gallons capacity, and into it there is practically a continuous supply. From this point a 12 inch cast iron pipe is laid a distance of 640 yards to a turbine and dynamo house at the foot of a glen, the fall being 170 feet. There are two turbines, each driving a separate dynamo, so that the plant is in duplicate, each being capable of running the whole installation. The two Thomson 12 horse-power turbines are fitted with ordinary sluice valves and have modified Pickering's governors. The dynamos are coupled direct to the turbines. They are of Mavor and Coulson's type. The dynamos run at 1,000 revolutions, the voltage being 135 and the amperes 75. The current may be sent direct to the mansion house or passed to storage cells, as in a separate room in the same small building there are fitted a set of 54 electrical power storage batteries, so that with the water storage, duplicate generating plant and this electric storage, there is little likelihood of the current failing. Ordinarily the supply will be taken direct from the dynamo, and a special automatic arrangement has been fitted for stopping the machinery at any given time. In the dynamo house there is a clock with an arrangement similar to that on the household alarm clock, a weight being dropped, which gives the lever of a four-way cock the necessary turn to work a valve on the water pipe. There being two turbines, the valve has two brass seats. The pipe on which the four-way cock is placed gets supply from the main, and in its operation admits water to the top or to the bottom of the valve to open or close it, as desired, so that the movement of the lever is sufficient to admit or stop the passage of water to the turbine. The advantage is obvious, as with the electric batteries charged it is possible to stop the generation of electricity at a time when the utilization of it for the night has ceased. The switchboard is very compact, admitting of the dynamos being used independently or for passing the current to the batteries. There are resistance frames to each, two ampere meters, voltmeter, two automatic cut-outs, electricity meter, and generally all requisites of a first-class installation. The whole installation is on Mavor and Coulson's concentric wiring. The mains have copper wires in the center, then insulating substance, wiring for the return, all inclosed in a lead pipe with sheathing for protection. There are three 32 candle-power lights, a large number of 16 candle-power lights, while the drawing-room is beautifully illumined by imitation candles of five candle-power each in groups of five. The work has been carried out by Messrs. Mavor and Coulson, Glasgow, the engineer in charge being Mr. Thomas Scott.



View of the Anderson & Horton Lubricator for Power Stations.

A committee of the city council has been appointed at Kansas City, Kansas, to consider the proposition of the Fort Wayne Electric Company to construct a new electric light and power plant for the city, and run the same for the city, or sell, as the city chose.

The World's Fair.

Applications for space in the Electricity Building at the World's Fair aggregate 388,000 square feet, while only 185,000 feet are available. Foreign nations have already been assigned 68,000 feet, and several of them are urgently asking for more.

Seats will be provided at the World's Fair dedicatory ceremonies in October for 1,500 newspaper correspondents, it having been estimated that about that number will be present.

Plans for the World's Fair passenger station at Jackson Park call for a main station 150x300 feet, with an annexed trainshed 100x672 feet. Provision is made for loading and unloading 36 trains at one time on reserved tracks.

ELECTRIC LIGHT NOTES.

The new Edison plant in Providence, R. I., is expected to be in operation early in October.

Enough subscribers have been secured to warrant an electric light plant at Shell Lake, Wis.

An order for a new 600 lighter has just been given by the Deckertown, N. Y., Electric Light Company.

Muskegon, Mich., wants to contract for a plant of 150 lights for five years. Muskegon can be accommodated.

An increase to the electric light plant is going on at the B. & O. yards, Newark, O. Three dynamos will be used in all.

Fort Worth's new electric light system is said to be working to the satisfaction of all the citizens of this progressive Texan city.

The Chesapeake Light and Power Company, at Hampton, Va., opened its station September 2. A reception was held at the works.

Hummelstown, Pa., is planning to convert an old grist mill and its water power into an electric light plant. But tear down the old mill!

The Chicago Edison Company proposes to build at Harrison street and the river what will be the largest electric light and power plant in the world. It will cost $1,000,000.

The Edison Company at Cincinnati will show what it can do in the way of a new style of handsome poles. Berlin has set a very good example in this respect, as shown by illustrations in the REVIEW a few years ago.

For some time past rumors have been published that the stock of the Edison Electric Light Company of New Orleans was being bought up by outside people. Last week it became definitely known that these rumors were correct, when it was announced that Fort Wayne capitalists had purchased the Edison company's plant for $150,000.

The Havemeyer building, which is claimed to be the handsomest office building now being erected in New York city, is going to be equipped electrically in the most perfect manner. It will have an installation of over 3,000 incandescent lamps. The wiring will be done in Interior conduit throughout, and the generating plant will be of the most modern type, the dynamos being directly coupled upon the shaft of the engine. The whole contract for the entire electrical equipment has been awarded to H. Ward Leonard & Company.

The Elmira, N. Y., Electric Illuminating Company are building a new plant, and have placed the contract for the iron roofs with the Berlin Iron Bridge Company, of East Berlin, Conn. The dynamo room will be 66 feet wide by 177 feet long, covered with the Berlin Company's patent anti-condensation corrugated iron roofing, the floor space being controlled by a ten ton traveling crane. The boiler room will adjoin the dynamo room and will be 32 feet wide by 75 feet long. When completed this will be one of the finest electric light plants in New York State.

Electric arc lights have been placed on the front lawn at the penitentiary, Columbus, Ohio, for the purpose of preventing escapes at night. Under the former system of lighting a prisoner might easily descend from the top of either east or west hall in the shadows and escape, but under the glare of 2,000 candle-power electric lamps this will be impossible, save in the event of gross negligence on the part of the front guards. Had these lights been in place an escape of a few weeks ago could not have been made. It is an old saying that one arc light equals 10 policemen, and progressive communities everywhere are finding this out. Don't be afraid to increase your city lighting, Mr. Mayors; it pays well.

National Physical Laboratory Discussed by the British Association.

Professor Schoute, of Groningen, gave a description of the physical laboratory there, which had been built with a view to carrying out researches in the most accurate manner possible. The chief points aimed at were: (1) The elimination of disturbances from traffic; (2) that the free access of sunlight on all sides should not be obstructed; (3) that the foundation should be firm, but without transmitting vibration; and (4) that the presence of any iron in the building should be avoided.

Professor Lodge, F.R.S., then opened a discussion on the desirability of creating a national physical laboratory.

Professor Lodge said a science in its infancy might be, and must be, grappled with by the scientific amateur, or, at any rate, by the isolated individual to explore new and savage territory. As a science reached the stage when minute accuracy became possible and desirable, the labors of the amateur in those branches became increasingly difficult and inefficacious. A great weight of learning was now no longer an impediment, but an essential. The free and amateur way of cultivating science had its advantages, but it had some disadvantages. Some men could and always would work best in the old way. Others could do better as head of a good establishment, with an organized staff and thorough equipment. For these latter men, so far as physics was concerned, we had no provision in England. In the British Isles other subjects were not so ill-provided as was physics. Astronomy, natural history, biology and geology were well-equipped institutions. But for physics, what was there except the old universities, the new university colleges, and a teaching college at South Kensington? Of the work done by such bodies it was impossible to speak too highly, but he urged that there were very many investigations for which they were unsuitable, and which they could only undertake at disproportionate labor and sacrifice. The university and colleges had plenty of work lying to their hand, and they stood intermediate between the amateur on the one hand, and the highly-equipped Reichsanstalt, the Bureau des Poids et Métiers, or the National Physical Laboratory, on the other. There was much work for which it would be disgraceful to use our greatest men. A great number of precise and accurate observations could only be carried out by the patient and continuous labor of a trained and competent observer for a year or two. For many such trained and competent observers places would be found in the national laboratory. They need not be men of genius; they must be men of precision, of system and ability. Such men were not, indeed, common, but there must be hundreds of them for one great man of genius. They were sound, thorough workers, but they wanted a leader. Let them utilize these men and not waste them; establish a great national laboratory where congenial and fruitful work could be found for them, and there they would gradually find their level. In speaking of the work that should go on in such an institution, he brought as an example the Cavendish Laboratory, at Cambridge, where Lord Rayleigh, Mr. Glazebrook and other men reared in that splendid University were working. All these things now going on in various parts of the island were more appropriate to a central or government institution, with every possible appliance and aid to accuracy, with absolute standards ready for use, with rooms which could be set aside to a special purpose for several years, or, if necessary, for several centuries, and a staff of skilled assistants. An investigation in progress need not then be dropped by reason of lapse of interest on the part of the investigator, or his decease or removal. The staff would be immortal, and any research determined on and ordered by the head or by the governing committee might go on for precisely as long as their judgment decided to be right. The classes of work appropriate to the national laboratory were: (1) Extremely accurate determinations of fundamental quantities; (2) determination of physical constants and properties of materials; (3) maintenance of standards and issue of the verification of stamped and certified copies of the same for scientific and industrial use; (4) continuous record of certain phenomena supplementary to, but not necessarily interfering with, the similar work of Greenwich and Kew, and (5) the undertaking of certain determinate lines of research.

Mr. Glazebrook, F. R. S., called attention to some points which he had come across in his work at the Cavendish Laboratory, and which ought, in his opinion, to be matters for a national laboratory to take up. These were—first, the fact that the testing of coils and comparisons of standard could only be carried on at odd moments and when no great delay was caused. In a national laboratory this could be done systematically and expeditiously. Again, the question of secular changes in standards called for continuous and close observation.

Professor von Helmholtz gave an account of the formation of the Reichanstalt, of which he is the director. He said that the funds disposable for the work of the institution were about £2,500 per annum, exclusive of salaries.

Professor Rucker, F. R. S., called attention to the inefficiency of Kew for very accurate work, unless purely magnetic. He hoped that if the government took the matter up there would be no diversion into the new channel of the meagre funds which they devote at present to research work. He would be sorry to see teaching and research divorced, but the experience of Germany showed that there was no risk of it at present. With these provisions, he saw nothing but good in the proposal.

How the World's Fair will be Governed.

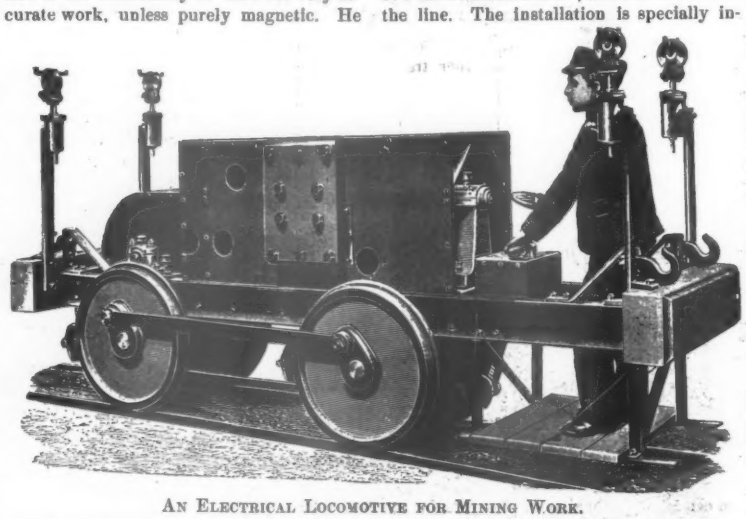
The chief governing body of the World's Fair is now a newly created council of administration, composed of two members of the national commission and two members of the Chicago directory, or local organization. The result was brought about by action of the joint board of reference and control of the commission and directory, and, it is believed, will greatly simplify and harmonize the government of the Exposition. On this council J. W. St. Clair and Geo. V. Massey were elected to represent the commission and President Higinbothan and Director Schwab from the directory. According to the terms of the agreement this council of administration will have final and exclusive jurisdiction in all matters pertaining to the administration of the Fair. Director-General Davis is given exclusive authority to deal with exhibitors, and is empowered to make requisition on Chief of Construction Burnham for any assistance which may be needed. Mr. Burnham's title is changed to director of works. He will have charge of the operating forces on the grounds. Both the director-general and the director of works are subject to the authority of the council. The four members of the council are to receive pay at the rate of $500 a month. The directory and the commission will assume the expense of their respective members. Mr. Higinbotham is president of the new council.

An English Electric Locomotive.

We are indebted to our esteemed London namesake, the *Electrical Review*, for the illustration of the electric locomotive shown on this page. It is for mining work underground, and was made by the General Electric Power and Traction Company, Limited. It was found impossible in the small space available to place the motor across the frame with its shaft parallel to the axles, so it was arranged parallel to the rails. Three reductions of gearing are employed, one necessarily being through bevel gearing. The whole framework of the machine is hinged from the driving axle, which is made exceptionally strong for the purpose, the weight on the other wheels being taken through strong spiral springs on the top of gun metal axle brasses.

The design of the "Immisch" motor, as shown, was chosen owing to the protection afforded to the field windings by this type of machine.

The motor is series wound for a difference of potential of 200 volts, and develops 15 brake horse-power at 1,000 revolutions per minute. The length of the road is 1,200 yards, and the current is collected from two bare copper wires carried on insulators overhead. The electromotive force is reduced from 500 volts to 200 volts by means of a motor transformer placed at one end of the line. The installation is specially interesting from the fact that a copious natural supply of water on the side of a hill is utilized as a prime source of power to drive a large vortex turbine, the water being conveyed down the hill through 15 inch pipes. A building has been erected on the hillside of this wild looking country, in which the turbine drives an "Immisch" four-pole dynamo which develops 100 electric horse-power at about 600 revolutions per minute. The dynamo is compound wound, with a working difference of potential of 600 volts, and supplies current also for motors driving pumping and winding plants, besides lighting the colliery, both above and below ground.



An Electrical Locomotive for Mining Work.

It is announced that the Postmaster-General of the United States has decided to issue a new series of postage stamps, with designs appropriate to the commemoration of the discovery of America.

New York will exhibit at the World's Fair sections of all the trees which are indigenous to the State. Of these there are 43 species and 85 varieties, a number which is not excelled, it is claimed, in any State in the Union.

"Marshall's gold nugget" will be exhibited at the World's Fair by California, and it is safe to say that thousands will consider it one of the most interesting of the innumerable objects which will be displayed at the great exposition. This is the identical nugget which Marshall picked up in the American river, February 16, 1848, when selecting a site for Sutter's mill, and which constituted the first discovery of gold in California. The nugget is about the size of a Lima bean, and, on account of its associations and the almost incalculable wealth and development which have resulted from its finding, is regarded as an almost priceless treasure.

ELECTRIC RAILWAY NEWS.

Milford, Mass., is taking a great interest in the new storage battery system perfected there.

The electric road at New Britain, Conn., is to be running inside of a year. It ought to be.

The Denverside Street Railway System, East St. Louis, will be converted into an electric one. It is owned by Denver capitalists.

A charter has been granted for an electric railway between Dillsburg and Gettysburg. The road will ultimately be extended to Harrisburg.

Over 140,000 passengers were carried the first month by the new electric road between Rockland, Rockport and Camden, Me. A heavy electric locomotive for freight and baggage service has been ordered.

The cars of the Brooklyn electric road, Richardson lines, are to be painted an olive green. This is a soothing and restful color, which we trust will not be at all typical, however, of the speed of the cars.

The General Electric Company has recently secured a contract against keen competition, whereby they are to supply to the Cass Avenue Street Railway Company, of St. Louis, Mo., 85 cars each equipped with two 25 horse-power motors of the well known standard W. P. type; three 800 horse-power direct coupled railway generators at a speed of about 90 revolutions. By this purchase by the Cass Avenue Company the entire system of electrical railroads in St. Louis is now solely equipped with apparatus manufactured by the General Electric Company.

President T. Lowry, of the Minneapolis, Wis., street railway, announces an enterprise that is going to be of great importance to that city. It is the organization of the Minneapolis Improvement Company, Northeast, with a capital of $2,000,000, of which he will be president. The company will proceed at once to the location of manufacturing plants. The electric lines will be extended into the grounds and extensive improvements will be made in their development. Mr. Lowry has associated with him in the enterprise several of the wealthiest men in the city, among them being ex-Gov. Pillsbury and F. G. James.

Stray Shots for Advertisers.

[By Artemas Ward in *Puck*.]

The repetition of advertising is one of its main forces.

Advertising is a reminder as much as an introduction.

If Sir Isaac Newton forgot for the moment that he himself could change his seat when he was so absorbed in his work that he asked the maid to remove the fire!—if Dean Swift could forget his own name on the threshold of a friend's house—if the greatest are liable to abstraction so intense as to make them forget the simplest things; surely the mass of mankind cannot escape the same tendency. The advertiser's emblem should be the Forget-me-not!

Turn again to the force of repetition and see how it reacts on the worker in the advertising field. I am often surprised at the lack of faith in advertising shown by the oldest agents in the field. They are led to doubt the value of their own papers because of the constant repetition of that "old song," "We have not had a single reply to our advertisement." At last the poor solicitor feels that it is taking a man's money unfairly when he secures an order. Like cures like, say the Homeopathists, and if the advertiser has repeated that statement so frequently that it is finally believed, just so the repetition of his card will finally secure belief for his claims.

A newspaper solicitor went into a bank, the president having signified his desire to advertise some property. The rate was $8.55 a month for an inch. The banker urged that it be made "even money." The solicitor admitted that he could do it, but positively refused, because it would be breaking an agreement with his employers and with others. The banker urged the point, and said, "I think you are too conscientious," but the solicitor stood firm and got his figures. Several years afterwards, when that newspaper man bought a paper of his own, his note was offered at the bank. It went through at once, for the president said, "I know that man and he lives up to an agreement."

MEDICAL ELECTRICITY.

Some Physiological Observations on Broken Currents or Intermittent Currents—A Very Timely and Valuable Discussion.

EDITED BY DR. J. MOUNT BLEYER, NEW YORK.

Claud Bernard was referred to by Mr. D'Arsonval at a recent meeting of the Société Internationale des Electriciens. His experiment consisted in placing a leg of a frog, a voltameter, a battery and an interrupter in circuit. He found that while a continuous current was flowing the frog's leg was not affected, but the voltameter* disengaged gas; when, however, the interrupter was actuated the leg became violently contracted, but the disengagement of gas ceased, thus showing that the muscular effect is not entirely dependent upon the current strength. If the current is very strong, then an effect is produced in the muscles when the current is steady, but it is an electric effect (meaning a chemical decomposition effected by means of an electric current).

PROFESSOR E. J. HOUSTON ON THE PHYSIOLOGICAL EFFECTS OF ALTERNATING CURRENTS OF HIGH FREQUENCY.

In reading an item of interest like this one, to many who are not so versed in the electrical vocabulary or meaning of such technical terms made use of in the electrical world, is the first difficult point that presents itself towards understanding any allusion or matter discussed in any paper. Let me, therefore, give you the definition of the term alternating current before going further to explain the effects of such a current as given here by Professor Houston. An alternating current is one which flows alternately in opposite directions. A current whose direction is rapidly reversed.

Before the electrical section of the Franklin Institute a communication was presented by the professor on the above subject. Professor Houston said: "A principal cause why discharges of enormously high frequency of alternation should be so comparatively harmless," he suggests may be found in the appreciation of "the modern ideas of how an electric discharge is believed to pass through a conducting path or circuit to the human body." He defines "the modern idea" as that which supposes the energy of alternating currents to sink or soak from the surface of a conductor towards the center body, while the impulse continues, and when the direction of the impulses changes it moves in the opposite direction and towards the surface. From this follows that "in the case of alternations of very high frequency, the central portions of the conductor are entirely free from electric currents, the current being limited to the portions near the surface." If we may regard the human body as sufficient, like an ordinary conductor, this seems in one way a very possible explanation of the harmlessness of such currents. It is said by the ELECTRICAL REVIEW in their columns, "How unfortunate, however, that Professor Houston does not give us some idea as to how far the effects of the same current strength at different frequencies has been taken into account." In Tesla's experiments (upon observations connected with which Professor Houston apparently bases his paper) it said the main cause of the harmlessness of the currents used lay in the fact that they were transformed till voltage† became everything and the ampereage‡ practically nothing. But authorities say that if it can be shown that by the mere increase of frequency, when the electromotive force and strength of current remain the same, the possible harmful effects upon the human body are eliminated; then they say that the conclusions of Professor Houston are thoroughly justified, but there is nothing to indicate this in the paper read. In his final statement, which is doubted, he said: "If these views are correct, it would appear that, when the human body is exposed to rapidly alternating discharges, it is subjected at one moment to a discharge that might produce instant death, were it not for the fact that the bolt is practically no sooner hurled at the body than it is hurled away from it." Of course, this may be, but the evidence of it is not yet forthcoming.

ALTERNATING CURRENTS FOR USE IN MEDICAL AND SURGICAL APPLICATION.

MM. G. Gautier and J. Larat have succeeded in utilizing for medical and surgical use alternating currents of high potential,* furnished by the Usine Centrale d'Electricité des Halles, at Paris. The dynamos which produced these currents were of a special type, called the "*Farranti-Patin;*" the alternations are 10,000 per minute, and the electromotive force,† 2,000 volts. Such high currents, it is superfluous to remark, are extremely dangerous, hence, in order that they may be used for medical and surgical purposes they have to undergo a series of transformations. The primary current of 2,000 volts undergoes a first transformation, which has the effect of conducting it to the apparatus under a pressure of 110 volts, when it ceases to be dangerous. By means of other transformers‡ this current is reduced so as to make it suitable for being led into a bath, a douche-bath, an ozonizer, a motor, a cautery apparatus, etc. Details of the installation are given in the *Comptes Rendus*, page 493. A remarkable influence on the economy has been noticed by MM. Gautier and Larat in the course of their investigations with these alternating currents, which appear to be due to two principal causes: First, a slow tetanization (cramp) of the whole muscular system. Second, a powerful reflex action on the ends of the motor nerves and also those of the sense nerves, extending even to the nerve centers. The effects of alternating currents employed in insulated baths upon the nutrition exchanges justifies the expectations that their employment may with care produce favorable modifications in certain affections or diathesic conditions, such as obesity, gout, rheumatism, and perhaps diabetes, etc., also in maladies caused by depression of the cerebro-spinal system. The experiments had been in regular progress some two-and-a half months before MM. Gautier and Larat felt justified in giving the preliminary results publication, and is said, as they rightly observe, it is only by studying a vast number of cases and observing their conditions over a sufficient lapse of time that it is possible to judge of the utility of a new method. They are busy studying the effect of the bath upon cutaneous affections. The application of the reduced current to cauterizing purposes turned out to be highly successful, and excels in convenience, as well as in effect, any other types of galvano-cautery. The transformer attached to this apparatus furnishes eight volts and from one to six amperes.§ A third transformer was employed in the production of ozone; it gives 1,000 volts with a current of 1½ amperes.

The ozonizer is formed of plates of glass coated each on one face with metal foil and separated from each other by a layer of air two millimetres in thickness. An automatic "ventilator" worked by the current conveys the ozone away from the plates as required. Twenty patients suffering from anæmie, tuberculosus, amphysemitic and other diseases, have been under treatment for more than two months with ozone thus generated, but without appreciable results. These experimenters appear to be extremely doubtful of the beneficial effects of ozone. It seems to possess a certain toxicity, for it easily induces vertigo, bronchitis, sore throat and allied affections; but it is possible that the ill effects may be due to the nitrous fumes which are always mixed with ozone that is electrically produced from the air.

THE CAUTERY USED FOR THE REMOVAL OF GROWTHS AND PILES.

The eminent Dr. Ephraim Cutter, of New York, champions the use of the electric current in the removal of growths and piles in a special paper read by him to a notable society. This mode of operating prevents bleeding, and generally ends with complete and perfect cure. That is, malignant growths are not apt to recur on site of removal; they may occur elsewhere.

It is found that the tissues heal healthily, so that it is difficult at times to locate the position of the growths which it formerly occupied.

Here are some of the principles laid down for successful use of the cautery and operation:

A good battery. If a storage battery, test it well as to connections beforehand. (The Edison-Lalande cautery battery must be highly recommended for all operative work. —ED.)

Dr. Cutter makes use of heavy conductors of pure silver. These are less bulky and more flexible than copper, carbon and zinc plates variously connected so as to be portable and not break; to have broad connections with as few breaks as possible.

In the ordinary coupling with screw and socket there is not a typical connector. The connection of batteries should have broad surfaces coming in close contact flatwise; in the ordinary screw coupling the contact is linear and tangential. Cam coupling. These are not likely to come apart, while screw couplings get loose almost invariably.

SEVERAL IMPORTANT POINTS ABOUT THE USE OF WIRE.

1. It must be small.

2. It is not an ecraseur. Platinum is not strong enough to cut tissues, and iron wire does.

3. Simply draw in contact with the tissues, then pass the current by a switch, or better, by dipping the plates of the battery in the solution.

4. Stop the current when things are getting too hot. There is no need of the adjacent parts being burnt. Besides, slow and broken applications allow of the sealing of the blood vessels, so as to avoid hemorrhage. Rarely do I have a hemorrhage.

5. After things have cooled, draw gently one end of the platinum wire and take up the slack, and fix by a sharp turn over end of tube. You are then ready for another application of the current. This letting the wire cut its way by burning is much different from cutting as an ecraseur. In the method here used there is no disturbance of the adjoining parts. With the ecraseur all the surrounding tissues are drawn in more or less, so that more tissue is taken in than needed. In the method here used there is no indrawing of tissue, and no taking more than is required.

The wire must always be white hot.

Hygiene at the World's Fair.

The exhibit to be made at the World's Fair, under the direction of the bureau of hygiene, will be of special public interest and value because it deals with sanitary subjects in every phase. Physical development, food supply, preparation of food, cooking and serving, dwellings and buildings, hygiene of the workshop and factory, food inspection, quarantine, reception, cure and protection of immigrants—these are a few of the subjects to be illustrated by the bureau. Every possible sanitary precaution that tends to prolong life and minimize the dangers from disease will be shown, either by actual appliances or models. Heating, lighting and drainage systems will be shown in contrast with exhibits illustrating the diseases and deformities caused by unwholesome trades and professions, or equally unwholesome quarters for the workingmen. Mr. F. W. Brewer, of Nebraska, has been nominated for chief of the bureau.

ELECTRICAL PEOPLE WE MEET.

Mr. C. J. H. Woodbury, vice-president of the Boston Manufacturers' Mutual Fire Insurance Company, is an advanced student of electrical matter, and possesses a mind well stored with general scientific knowledge. His work of looking after the interests of his company in the large factories of New England and elsewhere bring him in contact with many practical men, and this constant meeting has kept Mr. Woodbury informed of all the latest devices, and their name is legion, that are made use of by the superintendents of the largest establishments of New England. Mr. Woodbury's judgment of general technical matters is in much demand, and he is always "up to date" on electrical and scientific work and discovery.

Dr. Cyrus O. Baker, the platinum refiner, who obtained his medical title by caring for seasick people on a sound steamer, is one of the most popular gentlemen known to the electrical fraternity. Obliging and sincere, possessing a vein of humor that makes his presence always welcome, Mr. Baker numbers his friends by the many score. Although enjoying the social side of life, Mr. Baker is ever awake to the demands of his business, and is considered an authority on all matters relating to the very valuable metal he imports, a business that, it has been remarked, is like "dealing in gold dollars." As master of transportation for the National Electric Light Association, Mr. Baker has established friendly relations with the leading railroads, and the Association is sure of the best accommodations at the lowest rates obtainable. The next meeting, which occurs in St. Louis in February, 1893, will, no doubt, be largely attended by Eastern people, and a special train will probably be run from this city.

Two of the heaviest operators in local electric light companies of recent years are ex-Mayor Frank A. Magowan, of Trenton, N. J., and Franck Z. Maguire, of this city. These gentlemen have organized in the last three months large companies in Newark, Jersey City and Trenton. A consolidation of electric light interests has just taken place in the last mentioned city, and the new company will have Mayor Magowan as its president. This will be one of the first companies in the United States to own both Westinghouse and General Electric licenses. Mayor Magowan is an active and very successful man, and was the first republican mayor elected in Trenton in 26 years. He is largely engaged in the manufacturing business, and personally runs and controls a number of factories in Trenton. He is a young man of 35 years, a reputed millionaire and a self-made man. Mr. Maguire is well known in electrical and financial circles of this city, has spent a number of years on Wall street and is a firm believer in the commercial value of electric light. Mr. Maguire was for several years Professor Bell's confidential secretary and afterwards performed like service for Senator Fair, the bonanza millionaire. He attracted the attention of Mr. Edison and was given charge of important negotiations in connection with the phonograph. He is now devoting most of his attention to forming large central station companies for the Edison Company.

Col. Gardiner C. Sims, the able and highly successful engine manufacturer and World's Fair Commissioner, is probably the most widely known and popular representative of the engine industry in this country. A constant traveler, he is ever meeting the practical men in charge of power stations, where he is able to give points and where he is not a bit unwilling to receive them, being always alert for improvements. His company, at Providence, has always been in the front rank in engine development, and Mr. Sims was probably the first to realize the great future there was in electricity, and to reap a substantial reward by manufacturing an engine that electric light people wanted, and one that they got by the many thousands. A few months ago Mr. Sims became interested as vice-president in a strongly established bank in Providence, and is not a bit spoiled by the fact that he is now a "bloated bondholder" and a gentleman of considerable means, earned by his own skill and brains.

BI-POLAR.

* This is an instrument, an electric cell, employed for measuring the quantity of electric current passing through it by the amount of chemical decomposition effected in a given time. There are various kinds of voltameters and used for different purposes.

† This term is not very commonly used for either the electromotive force or the difference of a potential of any part of a circuit, as determined by the reading of a voltmeter placed in that part of a circuit.

‡ The number of amperes passing in a given circuit.

*An alternating potential means a potential the sign or direction of which is alternately changing from positive to negative.

† The unit of electromotive force is the volt When electric induction takes place, there results a change in the distribution of the thing called electricity, whereby a movement occurs that results in a positive and a negative charge. The cause which produces this movement is called the electromotive force.

‡ A transformer is an inverted Ruhmkoff induction coil employed in systems of distribution by means of alternating currents.

§ To explain an ampere it would be best to show its meaning by drawing a comparison. Since the ohm is the practical unit of resistance, and the volt the practical unit of electromotive force, the ampere, or the practical unit of current, is the current that would flow through unit resistance, under unit pressure or electromotive force.

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Prof. Elisha Gray has returned from an extensive European tour taken in the interest of the Electrical Congress which will be held in Chicago in connection with the World's Fair. He secured the promise of 200 electricians to attend the Congress.

The *Century* Dictionary is very complete and accurate in its definitions and illustrations relating to the telephone; and in fact its attempt to place before the general reader a clear statement of the meaning of uncommon electrical terms has met with remarkable success.

The overhead construction which forms a part of the present trolley system has been objected to very frequently on the ground of "unsightliness." Is there anything more "unsightly" than the average street car horse or Col. Elliott F. Shepard's Fifth avenue stage horses?

The disgraceful fight made against the introduction of the trolley in New York city by the press of this city has calmed down a great deal since the *Sun* injected a little common sense into the discussion. Intelligent readers are not imposed upon very long by unfair and untruthful newspaper statements, and since the REVIEW called attention to the fact that 98 per cent. of the accidents attributed to electricity were due to other causes—in fact, due to the same elements that prevail on the horse and cable roads—and the article copied and indorsed by the *Sun*, with its vast local influence, the editors of the other papers have apparently realized that their readers didn't approve of their course, and are devoting more time and talent to politics and prize-fights. We expect to see every one of these papers become firm advocates of the trolley lines, as they have all come to believe in the telegraph, the telephone and the electric light.

ALL FAVOR THE TROLLEY.

It seems almost work of supererogation to show that the trolley is not the death-dealing monster pictured by some of the daily papers. It has often been demonstrated that the fatalities charged against electricity are solely due to the increased output of transit for which all progressive communities are clamoring.

A very searching investigation has been recently made by the New York *Press*. In Chattanooga, Cleveland, Louisville, Peoria, Charlotte, Wichita, Cumberland, Hampton, Springfield, Mass., Burlington, Ia., Reading, Pa., Buffalo, Lynn, Terre Haute, Canton, O., Kearney, Neb., Grand Rapids, Great Falls, Montana, Newton, Mass., Long Island City, Oswego, Nashville, Savannah, Vincennes, Ind., Aurora, Ill., Dayton, O., Holyoke, Mass., Findlay, O., Augusta, Ga., Little Rock, Ark., Joliet, Ills., Pottsville, Pa., Elmira, Akron, O., St. John, Neb., Brooklyn, Toronto, Lansing, Mich., Muskegon, Mich., Allentown, Pa., Fort Worth, Tex., Winston, N. C., Bangor, Me., Amsterdam, N. Y., Dubuque, Ia., Elkhardt, Ind., Paterson, N. J., Zanesville, O., Rockford, Ill., New Castle, Pa., Defiance, O., Baltimore, Marlboro, Mass., Helena, Mont., Concord, N. H., Hudson, N. Y., Joplin, Mo., Ottawa, Ills., Trenton, N. J., Oxford, Ala., Ottawa, Can., Springfield, Mo., Hannibal, Mo., Keokuk, Ia., Plymouth, Mass., Winnipeg, Manitoba, and Hot Springs, South Dakota, each having one or more trolley lines varying in length from 48 miles downward, the same feeling exists that the rapid transit afforded by the trolley lines in use is absolutely indispensable, and that such accidents as have occurred would have been just as certain to occur with cable traction or any other system of rapid transit. The mayors of the various cities report that the electric roads are highly popular, and as safe as they can be made, considering the speed of transit; that few accidents occur, because the people soon become educated to the high speeds and exercise due caution. It is found that the high speeds are a great factor in the growth of the cities. Here is a sample report from Wichita:

"One man has been run over and killed. Cause: He was drunk and asleep across the track in the suburbs, where there were no street lights and streets were unfrequented. It would have occurred with any motor line. No one has been seriously hurt with the electric current used by the railway."

It is time to call a halt on the sensation mongers. Electric traction is a creation of nineteenth century progress; it has come to stay. Whether in the form of a trolley supply or some better substitute yet dormant in the cradle of genius, it is a permanent fixture.

LETTERS FROM A LABORATORY.—XII.

BY JULIAN A. MOSES.

In the manufacture of chemical glassware, the principal form, that from which all others are evolved or derived, is the bulb or globe. The bulb is the most important, for it is in but very few instances that the perfect globe is desired. There are two forms of bulb, while it is in the process of manufacture, one that is blown with one handle, and the other which possesses two. The former is the easier to blow, and it is of this one that I shall speak first. Draw both handles on the tube, and then remove one as before described. This leaves a hollow pear-shaped mass of glass on one end of the handle, which must be treated carefully, otherwise your bulb will not be a success. Holding the handle in the right hand, turn it back and forth in the flame until the mass is evenly heated from the extreme end to the handle; then blow gently. This blast will take out any irregularities that at first appear. The glass as it melts will tend to drop or become more heated at one point than at another; this can only be avoided by an adroit and rapid turning of the handle, which must be obtained by practice. However, to help you along at first, it is advisable to have a large flame. This will not heat the glass so quickly, and will enable you to watch the mass as it heats more carefully than if you had a smaller and hotter flame. Do not try to obtain a bulb with one blast, as this is sure to result in failure. Only expert glass blowers can do this.

Have patience, and with one or two more blasts you will obtain what you require, which can only be done by turning the glass as it sags at different points. But always, no matter what happens, turn the glass *continually*. You will very likely find that you are a better blower than a turner, but do not be discouraged, as the turning will come in time, for it is more the result of experience than of immediate skill or aptitude.

There are a few simple rules in this, as in every other art, which if followed will save a good deal of time. The following are some that have proved of great value to me and I have no doubt will help you materially.

Do not forget that if you stop turning at any point, the glass will become hotter and softer and, therefore, will, when blown into, puff out at that part more than at any other. This is, of course, not the thing looked for when a perfect bulb is desired, but there are particular cases where this is of great use and advantage.

If you stop turning when the glass is soft, the mass will sink and it will be rather difficult to renew the shape without considerable inconvenience. It is in glass blowing, also, that the motto "Well begun is half done" is applicable.

The coolest part of the flame is near the opening of the tube of the burner, and the hottest part is at the end of the inner blue flame. If it is to be desired to heat a large object, it must be placed at the end of the flame, where it spreads the most. If you have a mass of heated glass and hold it end down, gravity acts on it and pulls it down, thereby elongating it. If the heated part be held on top, with the handle underneath, the glass will melt together, and the mass will become shorter and thicker. The one force that is of paramount importance in glass blowing is gravity, and it is the skill in overcoming and aiding this force that makes the expert glass blower. It is, practically, the only outside force that is used, as the glass is not often touched by any external tool or power other than the pressure, either inward or outward, resulting from the breath.

After finishing a bulb or any other piece of work, it is advisable to turn off the air blast entirely and reduce the pressure of the gas until a small yellow flame about two inches long is left. Put the piece of now heated glass into this flame and allow it to become well smoked. This smoking will temper the glass and prevent its breaking from too rapid cooling, a fault that is liable to happen only too often. After the bulb has been thus smoked, allow it to cool entirely before attempting to manipulate it in any way. The sooty coating should be brushed off with a long haired paint brush. A small stand for holding the pieces of apparatus may be constructed from a pine board about 12 inches square, having a number of holes placed at convenient distances, of sufficient size to enable the handles to be easily passed through. Never let the bulb touch anything while it is cooling, as a strain is produced which is liable to cause the glass to crack at any moment at that point.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. Henry S. Anderson, manager of the United Electric Light Company, Springfield, Mass., was in this city early in the week.

The Springfield, Mass., Electric Light Company has added to its equipment a 500 horse-power engine, and will soon add another 300 horse-power generator.

Mr. W. H. Allen, assistant New England manager of the Hartford Steam Boiler Inspection and Insurance Company, has been spending the month of August at Falmouth, Mass.

Mr. John A. Blattan, special representative of the Ries Electric Specialty Company, Baltimore, Md., was a visitor among the electrical interests of the Hub during the past week.

The General Electric Company recently furnished the Northwestern Terra Cotta Company's Works, at Chicago, an electrical tram road. The line is 1,700 feet long, including the loop.

Mr. B. E. Davis, a representative of Messrs. Pass & Seymour, of Syracuse, N. Y., manufacturers of electrical specialties and the celebrated "Syracuse china," favored this office with a visit on Thursday.

Mr. E. Ward Wilkins, of Partrick & Carter Company, Philadelphia, Pa., the widely known and popular electrical supply manufacturers, was among the prominent electrical people in Boston this week.

Messrs. Charles S. Pinkham & Company, of this city, are successors to the well known firm of Pinkham & Godfrey, electrical contractors, No. 88 Bedford street. Business will be continued as usual at same address.

Electrical Inspectors.—There is talk of forming a permanent organization of electrical inspectors connected with the various insurance organizations, for the purpose of discussing the various features of the electrical hazard and devising means to meet it.

The Shawmut Fuse Wire Company, Boston, has issued its new catalogue on tested fuse wire and fuse links. The pamphlet is neatly printed and profusely illustrated, and is worthy the perusal and attention of all dealers and consumers of fuse wire and fuse links.

The Factory Mutuals, associated for insuring electric light and power stations, wrote $700,000 of risks in August. They are finding plenty of good business at what they think are remunerative rates. The latter have been raised from the basis established by the old Electric Mutual.

Mr. J. Bradford Sargent, Eastern agent of the Stirling Boiler Company and C. and G. Cooper & Company, recently closed contract with Mr. Charles Heap, of Williamstown, Mass., whom he will furnish a 300 horse-power Stirling boiler and 150 horse-power Cooper-Corliss steam engine.

Messrs. Beatty & Hodgkins, electrical engineers, this city, have dissolved partnership and given up their office in the Rogers' building. The former has become identified with the new firm of Pinkham & Company. The latter has gone into same line of business for himself at No. 27 Kilby street, this city.

The Holtzer-Cabot Company, this city, reports its trade in electrical specialties unprecedently larger and its general business in electrical apparatus and supplies as very satisfactory. This company now has ready for the market its largest sizes of electric motors, ranging from one-half to ten horse-power.

Arc Current Indicator.—Messrs. Swan & Lane, of this city, are selling a large number of the meritorious electrical appliance above named, and numerous testimonials have been received from users of this indicator. Managers of electric light stations—central or isolated—not already using the indicator referred to, will find it to their interest to communicate with Messrs. Swan & Lane, 193 Summer street, Boston, Mass.

The Stirling Boiler Company, manufacturers of the Stirling water tube safety boiler, has issued a new catalogue. The book is an attractive publication, neatly illustrated with views showing a number of steam plants where the Stirling boiler is being used. The descriptive matter is interesting and comprehensive. The company's Eastern agent is Mr. J. Bradford Sargent, No. 620 Atlantic avenue, by whom the handsome catalogue is distributed to all who apply for it. W. I. B.

Boston, September 10.

OUR CHICAGO LETTER.

C. A. Spencer, of Grand Rapids, Wis., was among the prominent buyers who stopped in the city last week.

Albert Scheible, who is familiar to our Western readers as George Cutter's assistant, has just returned from a brief pleasure trip.

Geo. E. Horn & Company report sales of a large number of bells during the past month, and that Fall business gives promise to be very heavy.

George Cutter reports some large sales of Simplex mining wire from Chicago stock. He also has a corps of draftsmen working on designs for his new enamel rheostats.

J. J. McCartney, of the Railway Equipment Company, is in the city this week, having just returned from a two months' trip East in the interests of his company.

Chas. E. Wilson has severed his connection with the Railway Equipment Company, and has joined the forces of the "C. and C." Electric Motor Company, at their Chicago branch.

Prof. E. C. Sickles, late with the Wenstrom Company, of Baltimore, passed through Chicago last week on his way to Des Moines, where he is to build up a course in electrical engineering.

George A. McKinlock, treasurer of the Central Electric Company, nothing daunted by cholera reports, has gone abroad for a month on his vacation, and will visit Ireland and Scotland besides going to London and Paris in a semi-business capacity for his company.

W. C. McKinlock, of the Enterprise Electric Company, has just returned from St. Louis and reports business at their St. Louis branch still on the increase. George Dickinson has been added to the office force at the Chicago house, having this week been made secretary of the company.

The Armstrong Electric Elevator Signals, which have been used successfully at the Chicago Auditorium for the past three years, are to be used in a number of other sky scrapers, notably the Masonic Temple and the Monadnock building. They will be installed by the Elevator Supply and Repair Company, of this city.

Mr. Frank Broadhead and Miss Sadie Potter were married at Ottawa, Ont., August 29. The wedding cake for the occasion was furnished by the caterers R. E. Jamieson & Son, of Ottawa, and was baked in an oven heated by electricity. The oven is manufactured under patents of Thomas Ahern by Messrs. Ahern & Soper, of Ottawa, and is the first oven heated by electricity in practical operation in the world.

The Central Electric Company have taken the agency for "machines for painting mouldings," recently illustrated in the electrical papers, and manufactured by the Standard Paint Company, of New York city. These machines can be had from the Central Electric Company, or any of its branches, the Southern Electrical Supply Company at St. Louis, Mo., Gate City Electric Company at Kansas City, Mo., and the Western Electrical Supply Company at Omaha, Neb.

The National Electric Manufacturing Company, of Eau Claire, Wis., have increased the capacity of their factory by adding a two story brick building 100x50 feet to their plant.

A visit to their factory and to see their machines in course of construction is all that is necessary to convince one of the merits of their machines and the vast amount of business done by this company.

Their factory is equipped with the very latest improved machinery, and, although with a large force of men, are compelled to run 12½ hours daily, and are still unable to supply the demand, having orders for four months' work on hand at present writing.

Chicago, September 10. M. J. B.

PERSONAL.

Mr. George Dickinson has been elected Secretary of the Enterprise Electric Company, of Chicago. Mr. Dickinson has an abundance of experience, and will doubtless prove a valuable addition to the official staff of this company.

Edwin G. Reynolds, well known to the members of the Electric Club, having been clerk and manager for several years, has accepted the position of Eastern manager of the enterprising *Street Railway Gazette*, of Chicago. Mr. Reynolds will make his headquarters in the Electrical Exchange Building, 136 Liberty street, New York.

A Streak of Black Lightning—Who Will Explain It?

TO THE EDITOR OF ELECTRICAL REVIEW:

I mail you to-day a photograph of lightning that I made on the 9th inst., which I think the most interesting of any I have sent you. I never saw before so many converging (or diverging) branches in any electrical discharge. The lateral discharge is also a fine study. Myself and others saw distinctly during the storm a streak of black lightning.

Is this a reversal of the image on the retina of the eye? Or, how do you account for it? Several people saw it from different points. Yours very truly,

JNO. W. RUSK.

Haines Falls, N. Y., Aug. 11, 1892.

Fire in the Factory of the Bryant Electric Company, Bridgeport.

Two fires broke out in the factory of the Bryant Electric Company, at Bridgeport, Thursday of last week. The loss will only be about $200, fully insured. There will be no delay in filling orders. The fires originated in the wood-work around the chimney.

THE TROLLEY.

More Favorable Comment on this Much-Abused Rapid Transit Method.—Since the "Review" Took the Matter Up Many Editors See the Good That It Possesses, and Our Technical Brethren Also Fall into Line.

Unprogressive New York.

[Lowell, Mass., *News.*]

There is a good deal of senseless clamor against the trolley, according to Mr. Theodore Moss, New York's Commissioner of Electrical Control. He says "the trolley will increase property valuations 25 per cent. in the annexed district. They want means of transportation there, and the trolley system would give this, and would make a great boom in that part of the city." New Yorkers like to flatter themselves that they are more progressive than we are here in Lowell, but their anti-trolley clamor doesn't show it.

The Electric Car Preferred.

[Boston *Herald.*]

For street service in the central part of the city we are of the opinion that the electric car, whether with storage battery or with power derived from trolley wire, is greatly to be preferred to a cable car. One very serious defect that the latter has for usage of this kind is the uniform speed with which the cable is run, making it not always possible to adjust the speed of the car to suit the requirements of the moment. Those who have been in cities where cable cars are used will bear us out in the statement that the manner in which they are suddenly brought around corners would be productive of innumerable accidents in crowded and narrow streets, such as those we have in this city. Where there is a clear, unobstructed roadway the cable car may possibly be as useful and as safe as the electric car. On such a route as the Suspension bridge across the East river at New York we dare say that the service performed by the cable cars could not be improved if electricity was substituted as a motive power. But, on the whole, for independent, flexible and varied service, the electric car is to be preferred over this other means of transportation.

An Insult to Intelligent Readers.

[*Western Electrician.*]

Despite the frantic opposition of the calamity howlers of the daily press of New York, Mayor Grant has approved the action of the city council granting permission to equip several street railway lines in the annexed district with the overhead trolley system. There was no reason why the mayor should withhold his approval of the measure. It was demanded by the best interests of the city, and it was his duty to give it his official sanction. The action of the mayor is all the more noteworthy and commendable in view of the fact that the sensational New York papers, led by the *World*, have bitterly opposed the improvement. These attacks, inspired by malice, cupidity or ignorance, are a disgrace to American journalism.

On the other hand, it is a relief to read a word of encouragement and commendation for the trolley in the New York *Sun*. In a recent editorial that paper said: "There has been a great deal of dishonesty and nonsense in what some newspapers have printed about the trolley system." This is certainly true. It might be added that the big metropolitan papers are largely responsible for the opposition to the trolley system, and much of the matter published by them on this subject has been extremely unjust to the electrical concerns. Moreover, it has been of such a character as to be an insult to the intelligence of the readers of these papers.

No Better System Than the Trolley.

[Boston *Commercial Bulletin.*]

Although we believe the trolley wire system in some respects to be defective, it is, nevertheless, the best that can be used for street railway purposes to-day. We can understand why New York, which is now free from overhead wires, should object to the erection of new ones, yet if more rapid surface transit is wanted there is no better system to be used than that of the trolley wire. Many want the storage battery, but as yet no large roads are operated successfully by them.

Poking Fun at Slow New York.

[Newburyport, Mass., *News.*]

New York is still kicking against having the electric trolley system there, though the commissioner of electrical control says its introduction would be a great boom to the annexed district of the city. New York should wake up. What is good enough for Newburyport is good enough for the metropolis.

Recognized the Good Qualities of the Trolley.

[*Electrical Engineer.*]

It is a matter for congratulation that the aldermen have granted, with the Mayor's confirmation, an extensive franchise, with reasonable conditions, to the Union Railway Company, which will operate a number of trolley roads in the northern suburbs of the city, beyond the Harlem. The trolley is pre-eminently the best means of service for that region, and the inhabitants will, without doubt, soon be glad that they enjoy it. A few of them may now oppose it, but they will be like the people in other cities, who have no sooner seen the trolley cars go into operation than they have become frantically anxious to get them on every possible and impossible route.

This victory has been achieved in spite of the abuse and misrepresentation of a large part of the press, including not only some of the respectable papers, but also the *World*, which has been just as ready and facile in faking "trolley accidents" as it has in manufacturing "special cable dispatches." The trolley is not deadly and is not dangerous. It is a great and lasting boon to those in need of better transportation in our great cities; and we are glad to see that the New York *Sun*, with its wonted strong common sense in dealing with practical affairs, has recognized the good qualities of the trolley and has said the kindly, true word on the subject. The trolley car is here to stay and is destined to have at least as long a life as the steam locomotive, no matter what other great advances may be made in electric traction.

"The Deadly Trolley."

[From the Brooklyn *Times.*]

"The Deadly Trolley Again" was the heading used by some of our New York contemporaries to introduce the story of an accident to a street car conductor in Brooklyn on Sunday. It appears that the conductor in question was passing along the outside rail of an open car, collecting fares, when he carelessly allowed his foot to project outside and was caught by a trolley car passing in an opposite direction, thrown to the ground and seriously injured.

There is just about as much sense in blaming the trolley for this accident as there would be in attributing it to the malign influence of the planet Mars. Under the same circumstances a street sprinkling cart or a doctor's buggy would have produced a precisely similar accident.

The trolley is all right and the newspapers that try to get up a panic about it underestimate the intelligence of the people.

To Light the Metropolitan Museum.

The Park Board, of New York, opened bids for an electric light plant for the new north wing of the Metropolitan Museum of Art, and for a boiler-house and engine-room for the use of the Museum of Art buildings.

The New York Electric Equipment Company got the first contract at $21,400, and Thomas Dwyer the second at $47,700, they being the lowest bidders. The Electric Equipment Company recently secured the contract for supplying arc lamps and poles for Fifth avenue.

From the applications already on file it is estimated that more than 100,000 men will participate in the great civic parade at the time of the dedication of the World's Fair buildings in October. Electrical displays will be a conspicuous feature.

TELEPHONE HAPPENINGS.

The new telephone line between Rutland and Burlington, Vt., is to be completed this week.

The Michigan Telephone Company is improving its plant at Lansing. A new cable is being put up.

A number of new telephone lines are going up in the territory of the Sunset Company on the Pacific coast.

Cincinnati is waiting eagerly for the arrival of the long distance telephone system so she can talk with the metropolis.

The selectmen of Hanover, N. H., have granted the petition of the Bristol Telegraph and Telephone Company to erect its lines to South Bristol, Alexandria, Bridgewater and Hebron.

About 30 miles of telephone line was blown down by a recent storm at Newton, Mass., in the territory of the New England Company. Service at the West Newton office was entirely suspended for a short time.

All railway, telephone, telegraph and canal corporations in the State of Pennsylvania are obliged by law to file reports with the Secretary of Internal Affairs before August 31 each year. Several corporations have failed to comply with the law, and each is liable to a fine of $5,000.

The long distance telephone people are making great progress in the erection of the 70 feet poles along Centre street, Pottsville, Pa. The poles are put into position by the aid of a big single pole derrick and a team of horses. The poles used in Reading, it is said, are 90 feet high.

At San Jose, Cal., the tax assessment for telephones was made $50 per set, an increase of $25. As there are 305 boxes in use in the city, this will amount to $15,250. The whole assessment against the company now amounts to $17,680. This would seem to be an outrageously high assessment.

Work on the new telephone line to Arcata from Eureka, Cal., is progressing rapidly. The poles are up as far as Freshwater and the holes are dug to within a mile of Arcata. It is expected to have all of the poles in place by the end of the week and to commence stringing the wire next week. The line will require 380 poles.

The Charleston, S. C., Telephone Exchange is among the largest and best patronized within the territory of the Southern Bell Telephone Company. The exchange has about 600 subscribers, and the records show that the wires are constantly employed. The number of conversations had daily over the wires averages more than 5,000. The company has placed in the last year 52 business telephones and 10 residences. A very handsome mahogany multiple switchboard, sufficient to accommodate 800 subscribers, has recently been placed in the exchange. The exchange has recently added quite a number of public telephones. These have been placed in stores along the principal thoroughfares and in the most thickly settled parts of the city. They work automatically, and by dropping a nickel in the slot can be used with the greatest ease, and have proved a great convenience to the public. Mr. John M. Fogle is the capable manager of the exchange.

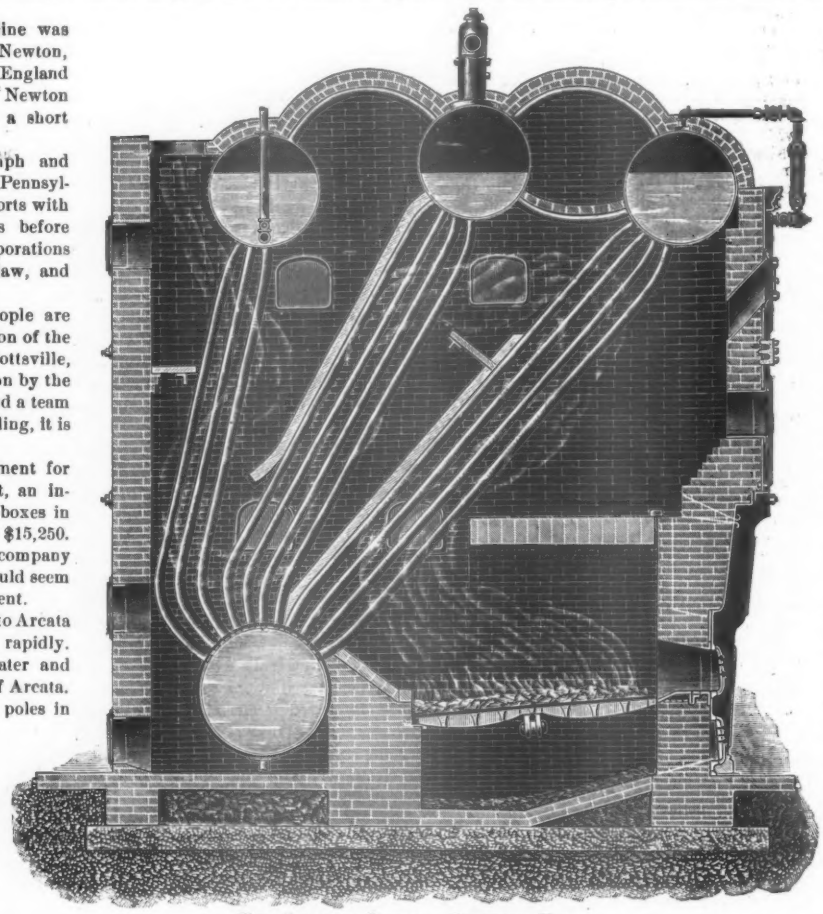
United Telegraphers of North America.

A dispatch from Kansas City says: The telegraphers' convention, which was expected to do wonders in the formation of a new union, to comprise all the old brotherhoods, etc., seems to have fizzled out. The proceedings have been kept secret, but it is understood there was an ugly fight over the constitution, which so disgusted many of the delegates that they left the convention and city. They decided to call the new organization the United Telegraphers of North America, and elect S. M. Bear, of Topeka, Kan., chief officer. There were only 27 present at the last meeting.

Work on the Chicago & Jefferson Urban Transit Company Line has been blocked by an injunction. It is founded on a bill of complaint filed in the Superior Court by Henry Lewis, who charges the council did not have the legal amount of frontage consent.

The Stirling Water-Tube Safety Boiler.

One of the most important features comprising the equipment of an electric light station is a reliable boiler. So much has already been written on this subject, and so many articles concerning numerous steam boilers have been published in these columns, that this illustrated description of the construction of the Stirling water-tube safety boiler will be brief. The accompanying illustrations show that the Stirling boiler differs materially in its construction from all other boilers. It consists of four drums 36 inches in diameter, connected with each other by a large number of tubes. The drums and heads are made of the best open hearth flange steel, with a tensile strength of from 55,000 to 60,000 pounds per square inch. The tubes are made of mild steel or of charcoal iron. Each tube is tested to a pressure of 750 pounds per square inch, and they possess the flexibility of copper with the strength of steel. The boiler is said to be absolutely safe, and cannot be exploded under any circumstances. The boilers are supported on wrought iron columns and girders, and are supported entirely independent of the brick-work. It is said that they will give far less trouble from leakage and repairs than any other boiler in the market, because there are no hand-hole plates to leak and no fire contact with riveted joints. It will seldom happen that a new tube will be needed, but if such is the case, one can be put in as easily and as quickly as in any other boiler. It is claimed, also, that the boiler is very reasonable in price. The Stirling boiler is making remarkable strides in public favor throughout the country, particularly in the West. The first plant of Stirling boilers in New England was installed by Mr. J. Bradford Sargent, the company's Eastern agent. This installation was made recently at the new station of the Hull Electric Light and Power Company, Hull, Mass., and consists of two 150 horse-power boilers set in one battery. The boiler room at this station is 30 feet square, and the engine and dynamo room is 40x50 feet, and contains the following equipment: Two Westinghouse alternating dynamos, with a total lighting capacity of 3,000 incandescent lights, three Fitchburg engines, two tandem compound of 160 horse-power each and one of 125 horse-power, two Wainwright heaters and Deane steam pumps and condensers.



THE STIRLING BOILER.—INTERIOR VIEW.

Homeless Storage Battery Cars.

We all remember those happy days when the Julien cars used to carry us down town on the Madison avenue line; how we used to wait for that particular car and enjoy the long ride, instead of having our lately eaten breakfast churned up by the jolting horse car, which we hope soon to see a thing of the past. The ride was so pleasant that we actually used to imagine that we were at the end of our trip before the car in front of us.

But those times have passed, the feminine portion of our community did not like the imaginary smell of the cars or the merry hum of the motor; or there was an infringement on somebody's patent, or some other reason; at any rate the storage battery cars were taken from the line and laid away to be attacked by the elements at the corner of Thirty-third street and Park avenue.

Time had gone his rounds, improvements had to be made in that valuable property, so the poor cars were obliged to go, and the other day we recognized our old friends, battered and scarred veterans, standing in the cold and rain outside the city of Newark.

Verily, we hope that the mighty have fallen but to rise again with renewed strength and vigor. YOUNG OBSERVER.

Roanoke, Va., is asking for bids for arc lights to displace 300 gas and oil lamps.

The Belton, Texas, electric light company is considering the putting in of water wheels to furnish the needed power.

The annual convention of the American Street Railway Association will be held in Cleveland, O., next month. The applications of electric power to street railway traffic, instead of the best manner of shoeing horses and raising oats, will be the chief topic.

The World's Fair souvenir coins, some of them, it is now expected, will be issued in November, probably by the middle of the month. The Exposition authorities have offered quantities of them to banks throughout the country at the uniform rate of one dollar each, and it is believed that those institutions will be prompt to avail themselves of the opportunity to get a supply for their customers. Orders for them are already being sent in at the rate of $5,000 to $10,000 a day.

Power Transmission by Alternating Current.

BY GISBERT KAPP BEFORE THE BRITISH ASSOCIATION.

Some two years ago the municipal authorities of Cassel, in Germany, determined to become purveyors of electric light and to place the generating station on the site of the waterworks pumping station, which is situated on the river Fulda, about four miles from the town. The object in choosing this site was partly to bring both undertakings under the same management, and so reduce administrative expenses, but chiefly to utilize an existing turbine plant which had been erected for driving pumps to augment the natural supply of water by gravitation, which was found in the hot Summer months to be scarcely sufficient for the requirements of Cassel. The gravitation supply being abundant during the rest of the year, the turbine plant and an auxiliary steam engine erected as a stand-by to the turbines represented so much idle capital during all the time that motive power was not required for pumping. It was thus obviously good policy to put the central electric station on the site occupied by the waterworks, using for motive power the turbine plant and stand-by engine already existing, and this the more so as the two services, namely, water and light supply, do scarcely, if it all, overlap. In Summer, when the greater part of the power obtainable from the turbines is required for pumping, the demand for light is a minimum, whilst in Winter, when the whole of the turbine power is required for lighting, the pumps need not be worked, the water supply by gravitation being, as already stated, amply sufficient.

Having laid down this policy, the problem to be faced was how it could be carried into effect; and this was not such an easy matter as might appear at the first glance. It would, of course, have been possible to lay down an ordinary alternating current station, but this would not have been a good solution of the problem. In the first place, the total number of lamps that could have been installed would not have exceeded 2,500 of 60 candle-power, corresponding with the maximum of 200 horse-power available at the pumping station; and in the second place, the low load factor of alternating current supply would have operated against the very object the municipality had in view, namely, to make the best possible use of their existing power plant. In order to carry out this object, it was obviously necessary to adopt some system of storage so that the turbines could work at full power continuously. With such a system the number of lamps installed could, at the same time, be materially increased. Thus, an ordinary direct current station with batteries might have given these advantages, but for one, and that a very serious obstacle, namely, the great distance between the generating station and the town. It was evidently necessary to work at high pressure and to use some system of transportation at a sub-station in the town, but high pressure direct current dynamos present difficulties which one would rather avoid than face, whilst the insulation of some 1,000 storage cells in series when charging, and their grouping in 10 parallels of 100 and regulation whilst discharging present very serious difficulties and introduce complications. It will thus be seen that neither the ordinary alternating current system, nor the ordinary direct current system with batteries, nor the so-called Chelsea system, presented a satisfactory solution of the problem involved in the lighting of Cassel. It was, nevertheless, solved in a very successful manner by a German engineer, Herr Oskar von Miller, who had been called in by the municipality to carry out the work. The plan adopted by von Miller was briefly this. He determined to transmit power by a single phase alternating current from the generating station to a sub-station or rather to two sub-stations in Cassel, and to use this power for the supply of direct current on the three wire system. At

one of the sub-stations he established a battery which is charged during the hours of light load, and assists the dynamos during the hours of heavy load, so that the maximum power available shall suffice for 3,500 sixty candle-power lamps wired.

The general arrangement of this installation is shown in the accompanying diagram. A_1, A_2 are two 60 kilowatt alternators at the generating station. These can be used singly or in parallel, and the current is transmitted through an underground concentric cable over a distance of about four miles to the substations shown on the right of the diagram. The sectional area of each conductor is .093 square inch, and the total

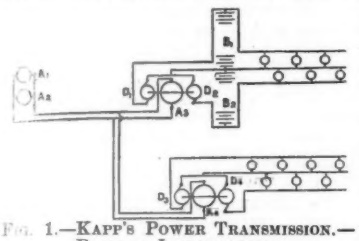


FIG. 1.—KAPP'S POWER TRANSMISSION.—PLAN OF INSTALLATION.

resistance about 3.5 ohms. The alternators are designed for a terminal pressure of from 2,000 to 2,200 volts, so that the loss in transmission, when both are working full power, is under 10 per cent.

Each substation contains an alternating continuous current transformer, consisting of a 60 kilowatt alternator, A_3, A_4, coupled with two continuous current dynamos, one on either side, D_1, D_2 and D_3, D_4, respectively. The latter machines are connected with each other and with the mains in the usual way adopted in three wire distribution. At one of the substations there is a battery, B_1, B_2, also arranged on the three wire system. The mains throughout the district are coupled so that the battery substation can supply current to the other substation through the town mains. To start only one of the two transformers it is only necessary to switch on the two dynamos, which begin to work as motors, and after observing by a synchronizer that the speed of the alternator has reached the required amount to close the high pressure alternating current switch, when the alternator works as a motor, supplying power to the two dynamos which are directly coupled to it. It will thus be seen that not only are the two alternators at the generating station worked in parallel, but also the two substation alternators, erected in different parts of the town, are worked in parallel. The dynamos are Brown's design and the alternators are my design, both made by the Oerlikon Engineering Works, but I must distinctly state that I can claim no credit whatever for the Cassel installation, and that the whole credit for this (probably the earliest) example of power transmission by alternating currents is due to Von Miller, who, at a time when most electricians were still in doubt as to the possibility of parallel running, boldly laid down a plant, the success of which was not only dependent on parallel running, but also on the economical and safe transmission of power by single phase alternating current, using for this purpose the ordinary type of alternator as made for lighting. The plant was started

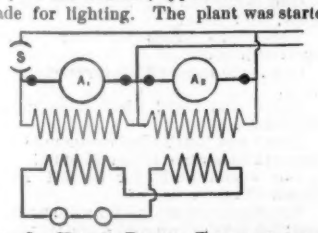


FIG. 2.—KAPP'S POWER TRANSMISSION.—ARRANGEMENT OF SYNCHRONIZER.

on May 15 last year and has been working since then without a hitch.

The arrangement of the synchronizer is shown in Fig. 2 where A_1 and A_2 are the two alternators which can be coupled in parallel by closing the switch, S. The terminals of the alternators are also connected by the two primaries of the synchronizer, the two secondaries being joined in series and connected by two 100 volt lamps, as shown. When the synchronism has been reached the lamps become bright, and at that moment the attendant closes the switch.

As will be seen by Fig. 3, the armature current is a function of the exciting current for any given load, and there is always one of the exciting currents for which the armature current is a minimum. It is obviously advantageous to work with this particular excitation, because the plant efficiency of the machine is then at a maximum. In Fig. 3 are shown curves representing the relation between armature and exciting current or static voltage of motor. These curves are determined theoretically and for three loads of 1 kilowatt, 10 kilowatts and 20 kilowatts, respectively. The dot at the curves represent the relation between the armature current and exciting current when the action is neglected, the full curves when it is taken into account.

By the courtesy of Herr von Miller, I am able to give the following readings of the working of the battery substation, taken at my request about a month ago. Although at that time of the year the load is necessarily light, the total efficiency of the transformer, even if we neglect the correction due to lag, is satisfactory.

ALTERNATING TO CONTINUOUS CURRENT TRANSFORMER.

Alternating Current Motor.

Speed.	Exciting Current.	Terminal Volts.	Armature Current.
500	10	1,820	23
460	10	1,800	20
475	10	1,840	20
475	10	1,800	22
470	10	1,800	22
465	10	1,820	22

Continuous Current Generators.

Machine I.		Machine II.	
Volts.	Amperes.	Volts.	Amperes.
130	120	134	130
112	120	113	120
111	125	117	115
120	128	116	118
112	127	128	110
122	115	120	122

DISCUSSION.

Professor Forbes said this was a most interesting method of lighting, and there were likely to be many applications of the same sort, and he believed these were the first

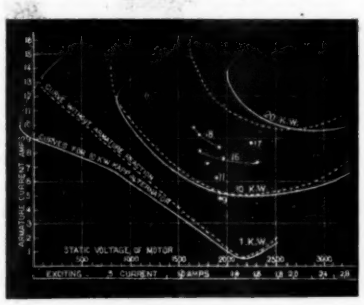


FIG. 3.—KAPP'S POWER TRANSMISSION.—CURVES SHOWING RELATION BETWEEN ARMATURE AND EXCITING CURRENT.

results giving us the efficiency of this combination. Electricians owe much to Mr. Kapp's ingenuity of resource in the way in which he brings such matters before them. He then asked Mr. Kapp if he had made any experiments to put the alternators out of step.

Mr. Preece said there is another point—it is this. Mr. Kapp has given us, for the first time, an answer to what has been often said to objections which have been raised with regard to alternating current systems, in connection with the use of motors and with the charging of secondary batteries. There was greater safety with high pressure alternating currents, because greater precautions were taken, and also stringent regulations were laid down, thus leading to greater safety.

General Webber threw doubts on the novelty of the system, and said, although he could not give an instance at the moment, he could probably recall several within 24 hours.

Mr. Kapp, in reply, said he would like to have some examples from General Webber, but at the same time pointed out that the system described had been running two years, and in answer to Professor Forbes said he would not object at all to break down the synchronism of the alternators; they simply made a fearful howl, but nothing more.

A New Application of Frictional Driving.

The Evans system of transmitting is now a familiar one to our readers. It has been before the public for some time, and is in use with great favor in many electric light and power stations.

The illustrations in this column are almost self-explanatory. The manufacturer states that 150 horse-power can be transmitted by use of an auxiliary pulley. Two dynamos can be driven by one pulley; one or both

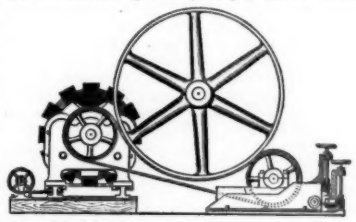


FIG. 1.—EVANS FRICTIONAL GEARING, WITH ONE AUXILIARY PULLEY.

can be started and stopped while the driving pulley is running. These advantages are self-evident and will attract the attention of all power users.

Telegraph Company's Liability—Damages.

In the case of The Western Union Telegraph Company *vs.* James, the Supreme Court, of Georgia, says *Bradstreet's*, held that while the contractual limitation of 60 days for presenting a claim for damages against a telegraph company does not ap-

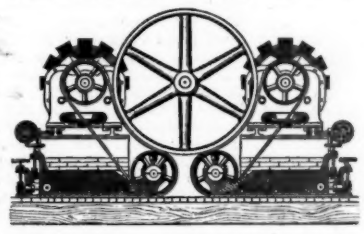


FIG. 2.—EVANS SYSTEM, RUNNING TWO DYNAMOS WITH AUXILIARY PULLEYS.

ply to a statutory penalty for delay in delivering a message, it does apply to all claims for special damages and operates not alone against the sender of the message, but against the receiver of it, where the message in question relates to the business of both parties and is a reply to a previous message sent by the receiver. The court said that where the damage done to the latter by delay in delivering the message was in breaking up negotiations for the sale of cotton of a low grade and preventing a sale which would otherwise have been consummated, the measure of damages would be the difference between the price which would have been realized by the sale contemplated and the value of the same cotton on that day in the market; or if there was no market for such cotton at the place where stored, its value at the nearest market to that place at which it could be disposed of, together with the expense, if any, of transporting it thither; that if it had then no market value anywhere, the measure of

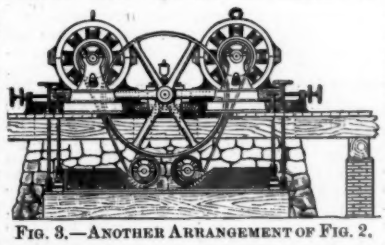


FIG. 3.—ANOTHER ARRANGEMENT OF FIG. 2.

damages would be the contract price less the best price which could afterwards be obtained for it on the first day it could be sold, and the expense of holding it until that day; that presumptively, in the absence of proof to the contrary, cotton has some market value on every day in the year; and that consequently a claim for damages would be practicable, and might reasonably be required, within 60 days from the time the message was sent, delivery having been made on the following day.

A Convenient Tool.

The "Dandy" double point tack driver, illustrated herewith, Fig. 1, shows the tool at rest with a double pointed tack protruding from the end. Fig. 2 shows the action of

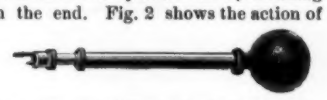


FIG. 1.—DOUBLE POINTED TACK DRIVER.

the tool in the position of having driven the tack in place. This little tool is useful in driving double pointed tacks into corners and places where an ordinary hammer cannot be employed. It is a great saving of labor, the use of the tool permitting the wireman to facilitate his work very materially.

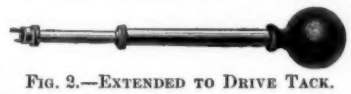


FIG. 2.—EXTENDED TO DRIVE TACK.

Telephone companies, and other large wiring companies where double pointed tacks are used, should find it very convenient.

Applications have been made for its patent, and the Central Electric Company, Chicago, are putting it on the market.

Transportation Exhibit at the World's Fair.

A very interesting exhibit in the transportation department of the World's Fair will be made by the steamship and railway companies of England. The collection of models of battleships, yachts, cruisers, steamers and merchant vessels will be more complete than was ever before exhibited. The London and Northwestern Railway will send over a complete train of cars headed by a great compound locomotive named "Great Britain." This will afford an opportunity to compare the English compartment cars and sleepers with American coaches. The Great Western Railway will exhibit the antiquated locomotive "Lord of the Isles," one of the first used on that road. Several of the railways will show their signaling systems.

A Successful Boiler Company.

The Stirling Boiler Company are crowded with orders and are running their works to their full capacity in order to keep up with the demand. These boilers give excellent satisfaction, as they are economical in the use of fuel, are very inexpensive to repair and seldom require any repairs at all. The heating surfaces are thin, being for the most part made up of tubes three and one-quarter inches in diameter and one eighth of an inch thick, and these are so placed as to receive the full benefit of the hot gases from the moment they leave the fire until they enter the stack. The boiler has received the highest commendation from its users, and the company has received many second orders, some of them being for 2,000 horse-power. In several cases the third, fourth and fifth orders have been received, so it can be plainly seen that the boiler is giving excellent satisfaction. Thirty thousand horse-power of these boilers have been sold in the last six months, and 7,752 horse-power from July 15, 1892, to August 20, 1892. The following is the list of sales made by the Stirling Company between the dates mentioned:

Clark & Windsor, Joliet, Ill.	200 h. p.
Grand Rapids (Mich.) Gas Co.	100 h. p.
Edison Electric Ill. Co., Altoona, Pa.	200 h. p.
Taplin, Rice & Co., Akron, O	132 h. p.
Windsor Hotel, Akron, O	50 h. p.
American Water Works, Braddock, Pa.	250 h. p.
G. ebel Brewing Co., Detroit, Mich.	250 h. p.
W. A. Wood's Harvesting Co., St. Paul, Min.	400 h. p.
" " " 2d order	150 h. p.
United Salt Co., Cleveland, O.	200 h. p.
Indianapolis Light and Power Co., Ind.	1,500 h. p.
Land and Imp. Co., W. Superior, Wis.	100 h. p.
" " " 2d order	70 h. p.
Montgomery Iron Co., Port Kennedy, Pa.	400 h. p.
Simpson & Watkins, Scranton, Pa	450 h. p.
Mobile (Ala.) Electric Light & Power Co.	350 h. p.
Sprang Steel Co., Pittsburgh, Pa.	500 h. p.
Armour Packing Co., Chicago, 3d order	700 h. p.
" " " " 4th order	1,050 h. p.
" " " " 5th order	400 h. p.
Charles Heap, Williamstown, Mass.	300 h. p.

Among the large contracts previously closed are the following:

Carnegie, Phipps & Co., Pittsburgh, Pa.	1,250 h. p.
San Francisco & San Mateo St. R'way Co.	1,250 h. p.
Pacific Rolling Mills, San Francisco.	1,500 h. p.
Braddock Wire Co., Braddock, Pa.	600 h. p.
Cincinnati Water Works, Cincinnati, O.	1,200 h. p.
Cold Storage Co., Chicago, Ill.	1,800 h. p.
Minneapolis St. Ry. Co., Minn., 2d order	2,000 h. p.
Toledo Water Works, Toledo, O.	1,500 h. p.
Armour Packing Co., Kansas City	1,000 h. p.
" " " " 2d order	2,000 h. p.

Shall We Erect Lightning Rods?

BY ALEXANDER McADIE, M. A., IN THE "AMERICAN METEOROLOGICAL JOURNAL."

In this country, as well as abroad, for some years past, there has been considerable doubt and uncertainty in the minds of thinking people as to the expediency of erecting lightning rods upon their buildings. The true function of a rod, it is true, is not easily comprehended, yet it is more than passing strange that, with all the plain directions and explicit cautiors from the many eminent minds that have studied the problem, there should still remain a wide-spread distrust of the methods in general use for protection against lightning.

"If I urge on Glasgow manufacturers," said Sir William Thomson, at the meeting of the British Association at Aberdeen, "to put up lightning conductors, they say that it is cheaper to insure than to do so," Now, this was the opinion of practical men, business men, concerned only with questions of cost; but it will serve as fairly typical of the views held by others, and quite generally held, too; and underlying this opinion one may readily perceive the belief that the risk was not great nor the protection so very certain. We are brought face to face, then, with the question, Does it pay to protect with our present methods?

Elsewhere can be found statistics, which although confessedly imperfect and fragmentary in character, leave no room to doubt that it certainly does pay to thus protect. The damage done by lightning in the United States yearly is no inconsiderable quantity that may be passed over lightly. When we see that the number of deaths due directly to the action of lightning averages something like 200 per year (take the year 1891, 205 lives were thus lost that we have an account of), and the damage to property, at a minimum valuation, not below a million and a half dollars; and, furthermore, that this is no isolated, exceptional catastrophe, but an established order of things, recurring with the regularity of the seasons, that part of our question which has reference to the amounts involved seems fully and definitely answered.

But do not let us assume for a moment that the liability to lightning stroke is the same for all places. The risk will vary greatly with locality. The Glasgow manufacturers answered the eminent man of science more wisely, perhaps, than they themselves knew. Thanks to the investigations of the Prussian Bureau of Statistics, we know, now, that these manufacturers were *in the main* right, for the reason that in thickly settled communities the risk is small compared with other localities. There are good reasons why, speaking generally, we can state that there is but little need for the erection of lightning rods upon buildings standing among others in city blocks. It is not true that such buildings are never struck. In the chapter on accidents, in a report upon "Protection from Lightning," it is clearly shown that under certain conditions the question of "exposure" seemingly has very little to do with the determination of the path of discharge of intense flashes. The case is somewhat analogous to that of the trees and rocks upon a mountain side, which, however much they may determine the course of small mountain streams, are powerless to influence the course of an avalanche or landslide. Sometimes, therefore, such buildings are struck and severely injured, and in exceptional cases, even where seemingly well protected; but for all that, it may still safely be set down that the erection of rods upon small city houses is not altogether a matter of necessity, as has been maintained by some.

Secondly. In cases of flashes of ordinary intensity, how certain is the protection afforded by a good rod? Few questions have been so thoroughly discussed from a practical as well as theoretical standpoint. No matter what Lodge's experiments may seem to indicate as to the uncertainty of our present methods, cold hard facts cannot be disregarded. We find that those who have gone deepest into the investigations of accidents resulting from lightning have seen clearly in the end, although sometimes after much doubting and perplexity, that the suggestion and plan of the American philosopher of 1755, for the protection of life and property from the dangers of lightning, are correct theoretically and in practice successful. What a list of names can be brought forward in support of this statement: Cavendish, Coulomb, La Place, Davy, Faraday, Harris, Henry, Von Helmholtz and Clerk Maxwell; Arago, Abbadie, Ayrton, Beccaria, the Becquerels, Babinet, Buchner, Charles, Canton, Callaud, Colladon, Clark, De la Rive, De la Rue, De la Tour, DeSaussure, Dulong, Despretz, Duprez, Duhamel, DuMoncel, Fresnel, Fizeau, Gay-Lussac, Girard, Henly, Holtz, Kirchhoff, Karsten, Mann, Melsens, Mohn, Nairne, Priestly, Pringle, Peltier, Poey, Poisson, Pouillet, Preece, Reimarus, Rochon, Regnault, Werner von Siemens, Tait, Tomlinson, Toepler, the Varleys, Watson, Wilson, Weber, Walker, Zenger and a host of others. And as a result of their labors we know that, provided certain precautions are taken, rods do effectually protect against the flash itself, as well as ward off the occurrence of discharge.

Snow Harris, perhaps, went more thoroughly into the question of the relation of the form of the conductor to protection than any one else. He experimented considerably, but, as a matter of fact, derived his best information from extensive study of the effects of actual flashes themselves rather than from laboratory work. And in this, in the long run, he proved himself wiser than Faraday. For Faraday, in 1850, seeing only the question of conductivity in the problem, said decidedly that this was a simple question of conductivity and that "*surface did nothing—the solid section was the essential consideration.*" The weight of his deservedly great fame settled the questions upon this basis for many years, although Harris, with the records of years before him, knew that whatever theory might seem to demand, the facts were plain that surface area was of very great if not equal importance with solid section in dealing with lightning discharges. So in the experiments of Dr. Lodge, to be referred to further on, there is some uncertainty whether or not he has really duplicated the natural cases.

But the public meanwhile was drifting somewhat into the position of that old British Admiral, who, being called upon to approve some specifications for a lightning conductor upon a certain light-house, although himself a believer in the surface theory of Harris, yet thought he would go down and consult Faraday about the matter. Now Faraday said very positively that the solid rod was better than the tube (which would give greater surface with less copper), that solid volume was everything, superficial area nothing, and that if Harris says otherwise, then "he knows nothing whatever about it!" The Admiral straightway approved the solid rod conductor for the light-house. Within a day or so he met Harris, and instancing the matter, the latter said, "surface area is most important, and if Faraday says otherwise, then he knows nothing whatever about it!" Small wonder then that the public should be likewise somewhat embarrassed by such conflicting directions from two such authorities. We now know that Harris was right (yet paradoxical as it may seem, Faraday's position *as far as it goes* is correct and unassailable; and his recommendations for all practical purposes, as important to-day as when made), but for nearly 40 years following 1850, and despite facts which proved the success of his methods in the protection of ships and public buildings, Harris' views on the importance of surface area were overlooked.

In 1882 came the report of the Lightning Rod Conference; and this is, in many respects, the most important contribution to the literature of the subject ever made. While so many foreign governments (and France in particular) had, by means of officially constituted boards, taken a governmental interest in the protection of the people from the dangers of lightning, the English speaking people of the world, aside from the few directions for the protection of magazines, light-houses, etc., were without any authoritative utterance to which they might refer. The Conference, while not strictly an official body, from the character of its members, carries even greater weight. It was simply a joint committee of representative members of the Institute of British Architects, the Physical Society, the Society of Telegraph Engineers and Electricians, the Meteorological Society and two co-opted members. As was to have been expected from such auspices, the report is an excellent one, and must stand for years as the embodiment of the most widely gathered information and well considered decisions.

In 1888 Dr. Oliver J. Lodge began his remarkable course of lectures upon the oscillatory character of the lightning flash. The views advanced by him are of such importance that the substance of each lecture is reproduced at length in Chapters V and VII of the Report above cited. It is enough here to simply emphasize the fact that if any electric current flows steadily in one direction in a cylindrical wire, its intensity is the same in all parts of the wire; but if, as shown by Hertz, the current be of an oscillatory character, *i. e.*, a current which reverses rapidly its direction, this condition no longer holds; and if the direction is altered with sufficient rapidity, the interior of the wire (in our case the lightning rod) may be almost free from current. "This," says Lodge, very eloquently, "is one of the direct results of the investigation of the propagation of electric waves in all media, the fruit which we now enjoy of the rich plantings of Maxwell (for whom, by the way, Faraday cleared the ground)." And this principle seems to Lodge to be of the utmost importance in investigating the action of lightning. "If lightning is a discharge of an oscillatory character, and some of us think that it is, then the theory of the lightning rod, as regards all that section below the point, requires alteration."

Of course, in places, this view of the character of the flash is at variance with the decisions of the Conference, and, in consequence thereof, a discussion (now famous) occurred at the British Association meeting in 1888. The honors seemed to be about evenly divided, for while Lodge had undoubtedly the clearer insight into the character of the lightning flash, the decisions of the Conference were not successfully assailed. The attitudes of the Conference and Lodge seem to me to be somewhat like the positions of Faraday and Harris.

If the reader is contemplating the erection of a rod, these points may be of service to him:

1. Get a good iron or copper conductor; if the latter, that which will weigh about six ounces to the foot, and preferably in the form of tape; if iron is used, and it is, perhaps, if anything, the better, have it in rod or tape form and weighing about 35 ounces to the foot.

2. The nature of the locality will determine to a great degree the need of a rod. Places apart but a few miles will differ greatly in the relative frequency of flashes. In some localities the erection of a rod is imperative; in others, needless.

3. The very best ground you can get is, after all, for some flashes, but a very poor one, therefore, do not imagine that you can overdo it in making a good ground. For a great many flashes an ordinary ground will suffice, but the small resistance of even one ohm for an intense oscillatory flash may be dangerous.

4. "If the conductor at any part of its course goes near water or gas mains it is best to connect it to them. Wherever one metal ramification approaches another it is best to connect them metallically. The neighborhood of small bore fusible gas pipes, and indoor gas pipes in general, should be avoided."—*Lodge.*

5. The top of the rod should be plated, or in some way protected from corrosion and rust.

6. Independent grounds are preferable to water and gas mains.

7. Clusters of points or groups of two or three along the ridge rod are recommended.

8. Chain or link conductors are of little use.

9. Area of protection. Very little faith is to be placed in the so-called area of protection.

10. Indifference of lightning to the path of least resistance. Nearly every one who has written of late years upon this question has taken it for granted that lightning always follows the path of least resistance. This is not true. "It is simply hopeless to pretend to be able to make the lightning conductor so much the easier path, that all others are out of the question," says Lodge. However, this requires some modification. The path will depend largely upon the character of the flash. For some flashes the statement as it stands above is true (and it can even be shown that at times points seem to lose their protective powers), but without doubt for almost all flashes a good lightning rod well earthed is the appropriate path to earth, and the rod may be relied upon to so act at the proper time.

11. Any part of a building, if the flash be of a certain character, may be struck, whether there is a rod on the building or not. Fortunately, this is the rarely exceptional case, the great majority of flashes in these latitudes being comparatively mild, and not at all as dangerous as we are apt to imagine them to be. We have instanced several cases where edifices seemingly amply protected have been struck below the rods (not to be confounded with cases of defective rods, etc.); and it is now becoming plain to us how (paradox of paradoxes) a building may be seriously damaged by lightning *without having been struck at all.* Take the famous Hotel de Ville, of Brussels, so well protected by Melsens' method, we might add, perhaps, the best protected building in the world, against lightning, and yet it was damaged by fire caused by a small induced spark near escaping gas. During the thunderstorm some one flash started up "surgings" in a piece of metal not connected in any way with the protective train of metal. The building probably "did not receive," says Dr. Lodge, "even a side flash, yet the induced surgings set up in it, induced by Maxwell and Heavyside's electro-magnetic waves, were so violent as to ignite some gas and cause a small fire." In other words, we had the condition of an "oscillator" in the cloud-flash-earth system, and the "resonator" in the piece of metal that responded with its little spark. In some experiments made by the writer during intense flashings, simultaneously with the flashes were seen small sparks between metallic ends, which we assume were of this character. We have to guard, then, against this heretofore unknown source of danger from within.

12. Unnecessary alarm. Many people suffer from alarm in addition to the sufferings due to nervousness during the prevalence of thunderstorms. Now, the fact is, that there are many flashes of lightning that the human body can withstand without very serious effects. Voltaire's caustic witticism "that there are some great lords which it does not do to approach too closely; and lightning is one of these," apropos of the death of Richman, at St. Petersburg, while experimenting, needs revision in these days when we deal daily with currents that are of greater electrical energy. Indeed, the other "*bon mot,*" "*Le ciel a plus de tonnerres pour épouvanter qu 'il n' a de fondres pour punir*" (Heaven has more thunders to alarm than thunder-bolts to punish), has just so much more point to it as it is nearer to the truth. One who lives to see the flash need not concern himself, or herself, much about the possibility of personal injury from that flash.

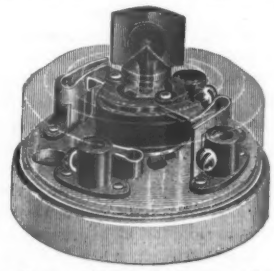
13. The notion that lightning never strikes twice on the same place is widespread, but erroneous; and we have plenty of cases showing the contrary to be true. The interval may be a day, a few minutes, or years.

14. Finally, if you should be in the vicinity of a person who has just been struck by lightning, go to work at once to try to restore consciousness. We have cases on record where after severe lightning stroke it has yet been possible to bring back to life the seemingly dead. We have reason to believe that many such accidents result in "suspended animation" rather than instant death. Try to stimulate the respiration and circulation; and do not cease in the effort to restore animation for at least one hour.

For an excellent illustration of a case of severe lightning shock and recovery, due it would seem almost entirely to proper and prompt management by the medical men present, see the *Medical News*, August 11, 1888.

The New Hart Switch.

The Hart & Hegeman Manufacturing Company, the well-known electrical manufacturers of Hartford, Conn., have just placed on the market their new double pole switch. Like all their switches, the



HART DOUBLE POLE 10 AMPERE SWITCH.

action of this one is very quick, and it is small and compact, and will fit inside junction boxes and is very desirable for interior conduit work. A view of the switch is printed herewith.

The Excellent Business of the Harrisburg Foundry & Machine Company.

The Harrisburg Ide and Ideal engines, built by the Harrisburg Foundry and Machine Works, Harrisburg, Pa., are rapidly securing a firm hold on the electrical and manufacturing interests of the country.

The following engines are being prepared for shipment in the next few days:

One 16x16, one 13x12, one 10x10 Ideals for Chillicothe Electric Railway.

Four 12x12 Ideals to be used in connection with the Waddell-Entz Electric Company, in New York.

Three 12x18 standard Ide engines for Hartford, Conn.

One 11x12 and one 7x10 for the Racquet Club, New York.

Two 16x16 Ideals for New York city apartment house.

One 14x20 standard Ide for Perth Amboy, N. J.

One 9 and 15x12 Ideal compounds for California.

Two 9 and 15x12 Ideal compounds for the Pennsylvania State Insane Hospital.

One 9 and 15x13 for the Mt. Pleasant Steam Printery.

These engines are all for shipment in the next ten days or two weeks, and they are also just shipping ten 100 horse-power steel return tubular boilers for a hollow ware company. These boilers are equipped with the Weitemyer furnace which will increase their efficiency at least 10 per cent.

The company have just furnished ten 100 horse-power boilers for the Central Iron, Harrisburg, equipped with the same furnace.

They are also setting two large boilers for the Alexandria Street Railway Company. Besides these orders, the company have work ahead for some three months and are compelled to work night and day.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

Electric Railways.

OSHKOSH, WIS.—The much mooted electric street railway matter has been settled by the common council granting a 50 year franchise to the Oshkosh company.

PHILADELPHIA, PA.—The Philadelphia and Ardmore Passenger Railway Company; capital, $40,000. President, Frederick P. Hayes; directors, D. S. Lindsey, Wm. Marks, Frank P. French and James Smith, all of Philadelphia.

SANTA CRUZ, CAL.—The Santa Cruz Electric Railway Company; capital, $500,000. Directors, James P. Smith, J. H. Logan, F. W. Ely, W. H. Talbot and A. G. Tanner.

SANTA ROSA, CAL.—An electric railway will be constructed from Santa Rosa to Petaluma.

NORRISTOWN, PA.—The Citizens' Passenger Railway Company is an applicant for permission to change its system to electricity.

DUBUQUE, IOWA.—The Eighth and W. Dubuque Street Railway Company has purchased the Key City Electric Railway.

HAVERHILL, MASS.—A project is on foot for the construction of a new electric railway from this city through Bradford and South Groveland to Groveland village. James H. Winchell, the leading manufacturer of the city, is behind the project.

PITTSBURGH, PA.—The Bellefield Street Railway Company, capital, $12,000, has been chartered, to build an electric line two miles in length. The road will be operated in harmony with the Pittsburgh traction system. The directors are Geo. W. Elkins, Wm. T. Elkins, Jos. Stuart and Geo. C. Wilson.

ABINGTON, MASS.—The Rockland and Abington Electric Railway Company has effected a permanent organization with the choice of E. P. Reed for president, C. N. Cobb, treasurer, and G. W. Kelley, clerk. The work of building the road will be commenced at once.

MCKEESPORT, PA.—The Versailles Traction Company has been incorporated by W. C. Sole, J. W. Bailie and others. The company has petitioned for a franchise for an electric street railway.

SALINA, KAN.—The company organized to build an electric street railway has commenced work and expects to have the road in operation by November 10. The company will put up an incandescent light plant for lighting residences and business houses.

PHŒNIX, ARIZ.—A number of Denver capitalists are organizing a company for the purpose of building a street railway at Phœnix. The road will be operated by electricity, and the company will be incorporated for $300,000. James A. Fleming, G. M. Harris, Granville Malcom and James Russell, all of Denver, are interested.

SHENANDOAH, PA.—The Ashland, Shenandoah & Mahanoy City Electric Railway has passed into the hands of a syndicate composed of Ohio and Pennsylvania capitalists. J. F. Bailey, of Philadelphia, has been elected president. Part of the road is under construction and this work is now to be pushed.

ASHLAND, PA.—A vast traction railway corporation has been formed, with quarters here, and a charter will be applied for September 26. The company will be known as the "Schuykill Traction Company," and the capital will be $600,000. The plan is to connect all the towns in the Mahanoy Valley with electric railways. J. F. Bailey, F. E. Bailey and J. H. Cofrode are the leading spirits of the enterprise.

DENVER, COLO.—The Denver, Lakewood & Golden Electric Railway Company will build a new power-house.

Electric Light and Power.

ERIE, PA.—The Edison Electric Light and Power Company will probably issue $200,000 in bonds for the purpose of improving its plant.

EDINBURG, IND.—An electric light plant will be established here.

MARSHFIELD, WIS.—The Marshfield Water, Electric Light and Power Company; capital, $100,000. Incorporators, Wm. H. Fritchman, Wm. H. Upham and Merrill H. Wheeler.

SHELL LAKE, WIS.—Enough subscribers have been secured to insure the immediate erection of an electric light plant.

SEATTLE, WASH.—Seattle Gas and Electric Light Company; capital, $1,500,000. Promoters, G. M. Nelson, St. Paul, Minn.; Lester Turner, R. C. Elliott, Seattle, Wash. Incorporation papers sent to Struve & McMicken, Seattle, Wash.

COLUMBIA, ILL.—Eagle Electric Company; capital, $7,000. Promoters, Henry Huch, Aug. F. Weind, Fred. Meyer, Wm. Gundlach, Thos. J. Cahill. Incorporation papers sent to L. Warnock, Columbia, Ill.

GONZALES, TEX.—The Gonzales Electric Light and Power Company; capital, $20,000. Promoters, W. S. Fly, R. H. Walker, G. N. Dilworth, T. F. Harwood, M. Eastland.

PORTLAND, ORE.—Salem Light and Power Company; capital, $150,000. Promoters, S. Z. Mitchell, O. F. Paxton, J. L. Hartman.

WEST TROY, N. Y.—The village trustees have ordered a special election to vote on the establishment of an electric light plant.

CHICAGO, ILL.—The Marengo Light and Power Company; capital, $75,000. Incorporators, Herbert A. Hawes, C. H. Cummins and J. H. Brandt.

SOCARRO, NEW MEXICO.—The Socarro Electric Light Company; capital, $25,000. Promoters, M. S. Hart, A. H. Whitmore, Paul A. Marcelino and others.

MARSHFIELD, WIS.—Marshfield Water, Electric Light and Power Company; capital, $100,000. Promoters, W. H. Upham, Frank Upham, W. H. Fritchman and others.

CLEVELAND, O.—The Economy Safety Heating Company; capital, $50,000. Promoters, W. W. Williams, Cecil L. Saunders, George D. Breck and Warner Bros.

PERRY, IA.—Perry Electric Light and Power Company; capital, $20,000. Promoters, E. A. Richards, Henry C. Hock, John Hock. Incorporation papers sent to E. A. Richards, Manson, Ia.

DULUTH, MINN.—Virginia Light and Water Company; capital, $20,000. Promoters, O. D. Kinney, A. E. Humphreys, Geo. W. Buck. Incorporation papers sent to J. A. Keys, First National Bank building, Duluth, Minn.

New Manufacturing Companies.

MINNEAPOLIS, MINN.—The Minnesota Hydro-Carbon Burner Company; capital, $100,000. Incorporators, F. C. Ball, F. L. Stetson and John Thornburgh.

BROWNSVILLE, PA.—The Dunlap Electric Company; capital, $50,000.

OCONTO, WIS.—The Electric Manufacturing Company; capital, $50,000. Incorporators, Geo. Beyer, T. S. Pampein and J. B. Grunnert.

New Construction Company.

MONTREAL, CAN.—The Street Railway Construction Company; capital, $80,000. Incorporators, Henry W. Darling, Marshall D. Barr and Alex. J. B. Close, all of Toronto; Robert Bickerdike, John Torrance, Charles Morton and Herbert M. Linnell, all of Montreal. The company is formed for the purpose of constructing and equipping electric street railways.

Consolidation.

KINGSTON, N. Y.—The Kingston Electric Light, Heat and Power Company and the Rondout and Kingston Gas Light Company have formed a consolidation. The new concern will be known as the Kingston Electric Company. The capital stock is $280,000, and the promoters are Robert B. Tabor, of Boston, and Frank B. Slade and George W. Blanchard, of New York.

Telephone and Telegraph Companies.

VANCOUVER, B. C.—The Cape Horn Telegraph Company; capital, $10,000.

Electricity Loose in Paterson, N. J.

In the Paterson, N. J., *Call* there recently appeared the following account of an interesting incident that stamps the reporter as a genius of a rare and brilliant kind, one who is not doing his talents justice in hiding them away so near the falls of the Passaic river. In describing the effect of a strong current wire becoming crossed with a telephone wire on which there were three stations, this New Jersey humorist says:

The frolicsome volts of electricity from the trolley wire went skipping along the wire to these three instruments, and their bells began to ring as if possessed. The undertaker's apprentice, the saloon keeper's bartender and the doctor's hired girl started pell mell for their respective telephones. The first one to get there was the undertaker's apprentice. He made a dart for the instrument, and had no sooner taken down the ear-phone than a blue streak of electricity a yard long shot over his head. He dropped the phone and shot out from the back door in a dead heat with the blue liquid flame.

The bartender nearly broke his collar bone in trying to round the corner of the bar to answer the terrifying summons of the clanging bell. He had no sooner taken down the ear-phone than a streak of greased lightning poured out of the instrument, and the latter collapsed with a report that started the bartender on a Virginia reel across the barroom. The hired girl fell over three cats and trampled down the doctor's pet dog in her anxiety to reach the noisy telephone. Down came the ear-phone, but before she could adjust it to her listening apparatus a hunk of electricity the size of a mince pie bounced out of the transmitter, singed off her new $6 bang and played tag around her ears. A wreath of smoke curled around her hair ribbon and she emitted a high chest-note and ran out of the house shouting "fire."

A moment later two firemen were running a line of hose over the doctor's velvet carpet. There was no blaze visible, so there was no fire to cope with, but when matters were explained the jolly firemen enjoyed a hearty laugh at the occurrence and went their way.

Marvellous Fahyahs!

ELECTRICAL CONGENIALITY ENABLES THEM TO WALK IN THE AIR, SAYS A BUCKEYE MUNCHAUSEN.

[From the Cincinnati *Enquirer*.]

The Fahyahs are the greatest legerdemainists, necromancers and hypnotists in the known world.

One of their principal feats is walking in the air. The Fahyah who performs it lays flat down with his face toward the earth for a minute or a minute and a half, then arises, and, forcing his arms against his sides, stands very erect, deliberately walks into the air as far as his power of endurance will permit him, at times reaching an altitude of from 250 to 400 feet, when he simply walks down again.

At first I could hardly believe my eyes, and I thought I had indeed seen a miracle performed. It took me over a year to understand this feat, at the end of which time I discovered that it was accomplished by a thorough knowledge of the electrical powers.

They thoroughly understand the laws of changing their electrified form from the positive to the negative by inhalation, and by that means, just the same as this universe is held in place by a congeniality of those two forces, so they utilized them in the performance of this feat.

To try to make it even clearer, I will go into the philosophy of the trick, starting from the first principles of electrical law, congeniality. Two persons are introduced to each other. Instinctively each party to the introduction knows whether there is a feeling of perfect congeniality or not. If there is a congeniality that proves that one is the positive and the other is the negative; if that feeling of congeniality is wanting, then they both possess similarly electrified forms, and naturally are repellant.

Of course, after associations may oft-times make two such similarly electrified forms friends, but 'tis very rarely the case. The same law precisely that governs the feeling of these men who have been introduced to each other is that which controls and keeps the universe in place.

The world is supposed to be 25,000 miles in circumference, 10,000 miles, more or less, in diameter; it revolves only once around the sun every 24 hours.

That is a pretty rapid rate of speed, it must be admitted, and naturally some force of electricity must be involved, call it positive. Then if the world is positive, space must be negative; otherwise one would be repellant to the other and we could not hold our place in the terrestrial firmament.

Now, if the world does hold its place by that law of electrical congeniality, why is it not possible for the man who possesses the knowledge of changing his electrified form from the negative, which we who inhabit the earth all are, to the positive by a process of inhalation, which he does when he lies upon the ground, and then walk into the same space, by the same laws that hold that tremendous globe and all the other planets and stars in their place?

That is the way, and the only way, by which the Fahyahs perform this most wonderful feat.

PROFESSOR (to class in physics): Now, describe this electrical machine, if you please.

HEAD BOY: It consists of a large glass wheel, turned by a crank. (Applause from the class.)—*Brooklyn Life.*

KINDRED INTERESTS

George Cutter, Chicago, is sending out a very neat pamphlet illustrating and describing Pattee's lamp hour recorder.

The Jewell Belting Company, of Hartford, Conn., is running a large force on electric light and electric railway belts, their business in this department being constantly on the increase. The Jewell belt is deservedly popular in electrical circles.

The E. S. Greeley & Company, Dey street, New York, is one of the oldest and most widely known electrical houses in the country. Their business is on a sound basis, their factory and laboratory work always first-class, and in every department kept up to the highest grade.

Messrs. Holmes, Booth & Haydens, of New York and Waterbury, Conn., are among the pioneers in the manufacture of electrical wire and have always held front rank in quality of goods and promptness of delivery. Their Fall business is reported to be opening up finely.

The Ries Electric Specialty Company, of Baltimore, Md., are sending large shipments of their regulating sockets, and orders are being received from almost every portion of America and the Old World where the alternating current is used. This company is shortly going to increase its plant again so as to meet the rapidly growing demand for its specialties.

The Shipman Engine Company, Boston, reports its sales during the past month very satisfactory and largely in excess of any previous month. Its foreign sales have been numerous. Among its shipments to points abroad were the following: To Walter Brown Wellington, New Zealand, 2 horse-power Shipman engine for an isolated electric light plant, and 6 horse-power Shipman engine to Rochussen Brothers, Melbourne, Australia, for an isolated electric plant.

The Shawmut Fuse Wire Company, of Boston, has just issued an interesting little pamphlet, well illustrated, describing the tested fuse wire and links manufactured by that company. The product of this company is of the highest class and the little pamphlet, which can be secured by addressing the company at 85 Water street, Boston, is a concise and important contribution in relation to questions of fuse wires, and should be in the hands of every practical electrician.

For Sale.

ONE Rice Automatic Steam Engine, 35 horse-power, 290 revolutions, 46 in. fly-wheel, 10 in. face; all nicely nickel-plated; and one 48 in. x 14 ft. steam boiler, 56 three in. flues, 26 ft. x 24 in. stack, 1,100 brick. The above has been in use four months in electric light plant; all in good working order. For further particulars, address,

N. H. ANDRUS,
VALPARAISO, NEB.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.
IF YOU want anything pertaining to electric machinery, send us your inquiries.
FRANK RIDLON & CO.,
Dealers in New and Second-Hand
Electric Light & Power Machinery,
196 SUMMER STREET, BOSTON.

A GOOD INVESTMENT.

$50,000 WANTED
TO START AN
Incandescent Lamp Manufactory
IN CANADA.

Incandescent Lamps to be manufactured by the new process of creating vacuum by METALLIC VACUUM PUMPS.

Address: "ENTERPRISE,"
Care New England Branch Office
ELECTRICAL REVIEW,
620 ATLANTIC AVE., BOSTON

Hulbert Steel & Mfg. Co. St. Louis, Mo.
Artistic Metal Workers
Brass, Iron and Wire Office-work. Railings, Gratings, Nettings, etc. Everlasting Cemetery FENCES. Shipped everywhere. Agents wanted. Write for Catalogue and Estimate.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 6 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 27 in. x 32 ft.; 88 in. x 31 ft.; 96 in. x 20 ft. Fox Lathes, 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.
Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 44 in. x 48 in. x 22 ft.; 60 in. x 49 in. x 24 ft.
Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.
Crank Shapers, 6 in., 8 in., 10 in., 12 in., 13 in., 16 in., 17 in., 20 in., 24 in., 28 in.
Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.
Screw Machines, Nos. 5, 6, 7, 8, Power Feed.
Presses, Nos. 51, 52, 53, Ferracute; Nos. 1, 2, 3, Stiles & Parker.
5 Lincoln Pattern Millers, No. 2.
Hand Millers, Nos. 1 and 2. 3 Cam Cutters.
Bolt Cutters, ¼ in. to 1 in., ½ in to 2 in.
2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.
C. D. and E. Horizontal Boring Machine. Newark Machine Tool Co.
Send for List of New and Second-Hand Machinery in Stock.
PRENTISS TOOL & SUPPLY CO., P. O. Box 3362, 115 Liberty Street, New York. 59 South Canal St., Chicago, Ill.

ELECTRIC CONDENSERS
WM. MARSHALL, MANUFACTURER.
Standards a Specialty.
Rooms 2 and 4, University Building, New York.

CHANDLER, FFRENCH & CO.,

1st NATIONAL BANK BUILDING,
KANSAS CITY, KANSAS.

ELECTRICAL SECURITIES.

Buy and sell Electric Light and Street Railway Bonds.
Promote and contract for the construction of Electric Light Plants and Street Railways.
Correspondence solicited.

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade.
Precision and Constancy, Quality and Finish the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
THE E. S. GREELEY & CO.,
5 AND 7 DEY ST., NEW YORK.

H. Ward Leonard & Co.,

No. 136 LIBERTY STREET, New York City,

BULK ELECTRIC CONTRACTORS
— FOR —
complete plants of every kind, including buildings, steam plants, water powers, electric generating plants, pole lines, underground work, road-beds, bridges, motors, inside wiring, etc.

Having no agencies and no connection with any manufacturing concern, we install any apparatus and any system desired.

NINE YEARS' EXPERIENCE.

SHAWMUT FUSE WIRE CO.

Highest Grade Tested Fuse Wire and Links.

Our entire product is tested for us by the Massachusetts Electrical Engineering Co., and their certificate of test accompanies each spool of wire and each lot of links.

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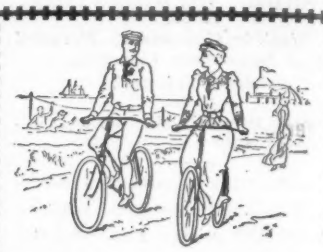

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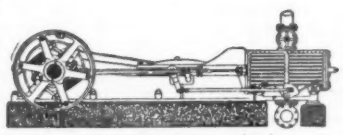

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